
Ex-libris
Charles Atwood
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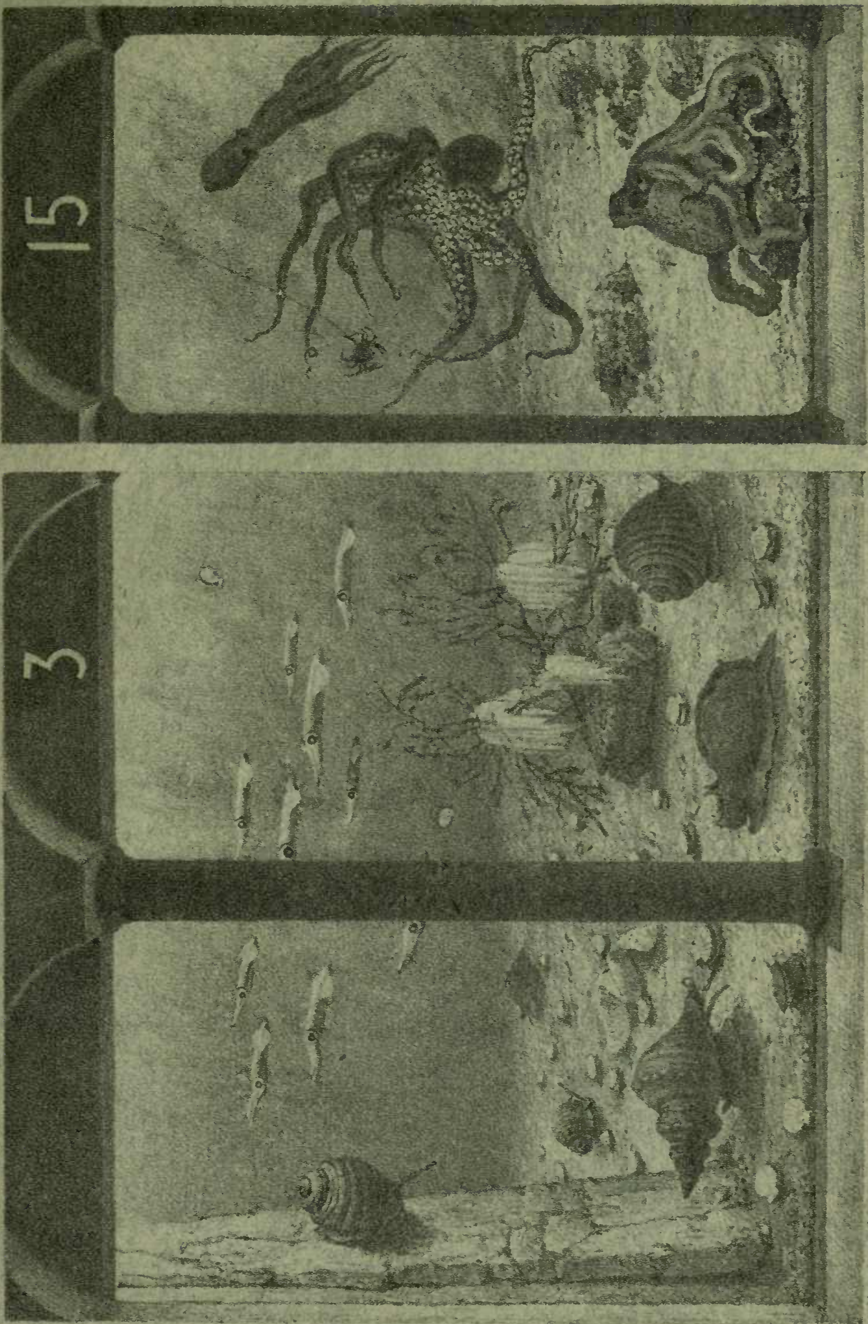
AQUARIUM NEAPOLITANUM.



Lith. Anst. v. Werner & Winter, Frankfurt a/M

Feb 3. 1898

GUIDE

TO THE

AQUARIUM

OF THE

ZOOLOGICAL STATION AT NAPLES.

FOURTH EDITION

WITH 175 ILLUSTRATIONS.

LEIPZIG

PRINTED BY BREITKOPF & HÄRTEL

1896.

PART FIRST.

LIST OF THE CONTENTS

OF EACH TANK.

The Aquarium contains only marine animals and plants. All have been found in the bay of Naples.

In the ensuing list only the most remarkable of the animals and plants are mentioned; the description given is purposely couched in colloquial language, being designed to convey, if possible, in a few words a sufficient impression of the animal to lead to its identification. The asterisk (*) before a name signifies that the animal does not occur at all seasons of the year.

The ascending streams of silvery bubbles in the tanks are the air drawn in by the sea-water, which is always being pumped in from dark tanks under the aquarium. Those animals and plants which are found near the upper part of a tank, will be seen double, owing to the reflection against the surface of the water. All the tanks, but especially, perhaps, Nos. 1, 3, 9, and 20, gain enormously by being seen in the sunlight between 12 and 2 o'clock.

On the walls of most tanks will be seen the white tubes of *Ciona* (compare tank 4), the colonies of *Botryllus* (p. 85) and other Compound Ascidians, and a little white Sponge (p. 55, fig. 159). These grow and breed in the water of the aquarium, attaching themselves to all suitable surfaces. In most tanks are swarms of tiny, reddish-brown Opossum-shrimps (p. 74). — In comparing the Fishes with the figures in the Guide, it must be remembered that in many species the dorsal fin nearest the head is not visible except when erected (often for defence): notice, as an example. *Labrax* (fig. 55) in tank 10. — The visitor must not rashly ascribe the power of walking about to Sponges, Tunicates,

Anemones, etc., which he may find moving among the rocks in various tanks. After seeing tank 23 he will be prepared to trace such vagaries to the little crab which is their cause.

Enquiries of any kind may be made of the attendant.

Tank Nr. 1.

Containing exclusively **Echinoderms** (p. 63).

1. **Starfishes** or "five-fingers", with five (rarely more) creeping arms: *Echinaster* (fig. 2), red and slender-armed; *Luidia*

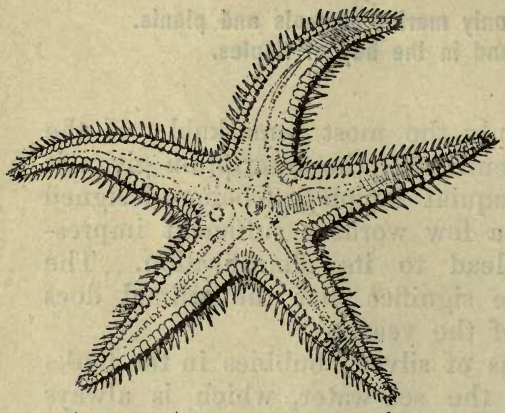


Fig. 1. *Astropecten aurantiacus*, 1/4 nat. size. p. 65.

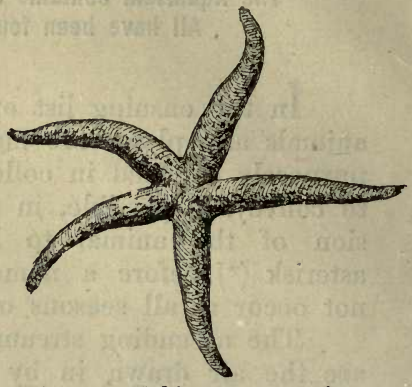


Fig. 2. *Echinaster sepositus*, 1/3 nat. size. p. 65.

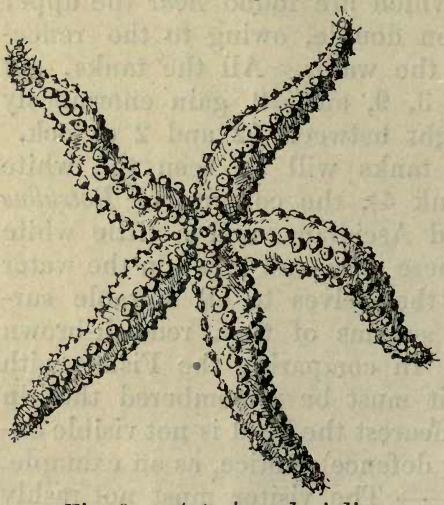


Fig. 3. *Asterias glacialis*, 1/3 nat. size. p. 65.

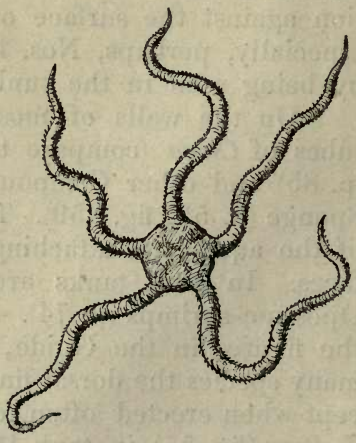


Fig. 4. *Ophioderma longicauda*, 1/2 nat. size. p. 65.

(fig. 6), much larger and generally with seven arms; *Asterias* (fig. 3), large and greenish, with pointed knobs; *Astropecten* (fig. 1), with points like little tusks fringing the arms; *Palmipes*, arms webbed, like a pentagonal piece of brick-red paper.

2. **Brittle-stars,** with five (rarely six) arms, thinner and more snake-like than the starfishes, round body like a thick half-penny (*Ophioderma*, fig. 4).
3. **Feather-stars** (*Antedon*, fig. 5), mostly holding by their backs to dead coral-stems (*Antipathes*, see tank 21) in the centre of the tank; they are yellow or red and have ten plumed arms.

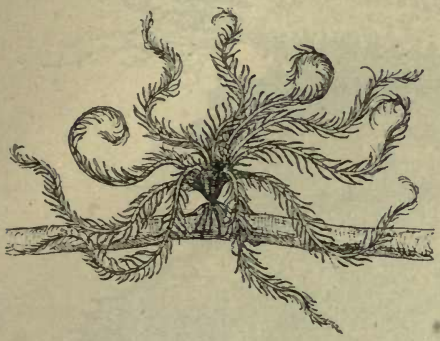


Fig. 5. *Antedon rosacea*, attached to a branch of *Antipathes*, 1/2 nat. size. pag. 65.

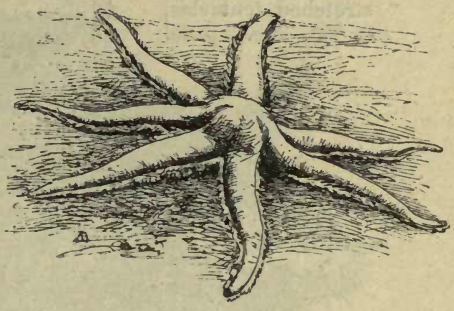


Fig. 6. *Luidia ciliaris*, 1/4 nat. size. pag. 65.

4. **Sea-urchins,** globular or bun-shaped, covered with spines. *Sphaerechinus* (fig. 7), generally purplish, spines tipped white; *Echinus* (p. 65), eight to ten inches across, spines white; *Dorocidaris* (fig. 8), pink with knobs, bearing a few strong, stick-like spines.

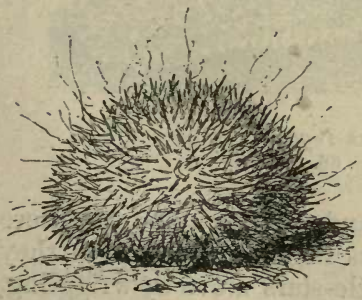


Fig. 7. *Sphaerechinus granularis*, 1/2 nat. size. p. 65.

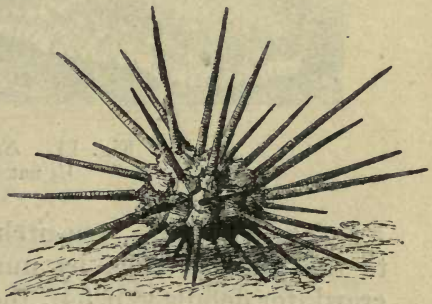


Fig. 8. *Dorocidaris papillata*, 1/2 nat. size. The sucker-feet are not visible. p. 65.

5. **Sea-cucumbers,** slug-shaped bodies, covered with pointed suckers. The delicate brown feathery undergrowth will be seen to be the tentacles of numerous sea-cucumbers (*Cucumaria*, fig. 9), adhering to the rocks; each has ten tentacles round its mouth, in crawling they are retracted; in the larger species (*Holothuria*, fig. 10) which is black, they are not obvious; *Stichopus* (fig. 11) is reddish, a foot long, and flat.

Fig. 9. *Cucumaria Planci*, on a stone, with outstretched tentacles, 1/2 nat. size. p. 65.

Fig. 10. *Holothuria tubulosa*, 1/3 nat. size. p. 65.

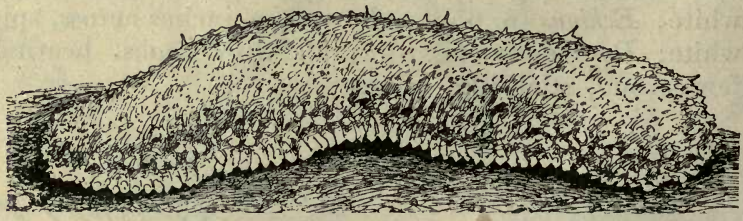


Fig. 11. *Stichopus regalis*, 1/2 nat. size. p. 66.

The starfishes, sea-urchins and sea-cucumbers adhere to the glass or rock by numerous suckers, with which they crawl (for details v. p. 64), the brittle-stars move by wriggling, the feather-stars can swim.

Tank Nr. 2.

Fishes: Sea-crow (*Corvina*, fig. 57), dark-coloured, dark lower fins. *Box* (fig. 12 and 13), silver with golden lines. *Oblata* (fig. 14), silver, with a black root to its tail. These all feed on the green alga, the lettuce sea-weed (*Ulva lactuca*) at the bottom of the tank.

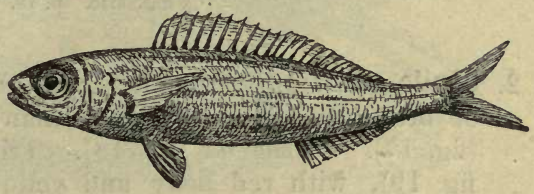


Fig. 12. *Box boops*, 1/2 nat. size. p. 97.

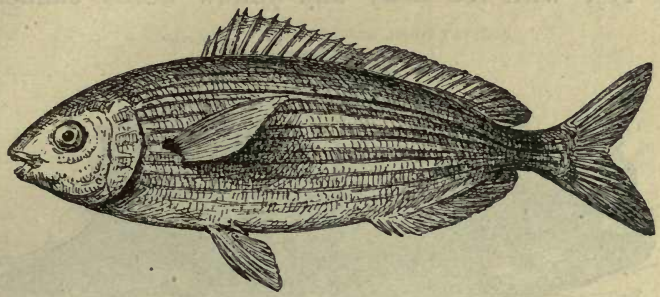


Fig. 13. *Box salpa*, 1/2 nat. size. p. 97.

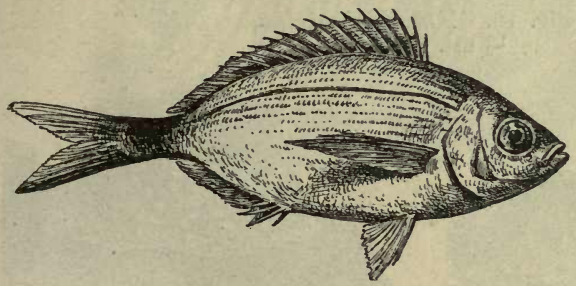


Fig. 14. *Oblata melanura*, 1/2 nat. size. p. 97.

Tank Nr. 3.

Containing **Mollusks.**

1. **Cephalopods** (p. 76). *Squid or Calmar (*Loligo*, fig. 15), delicate, transparent, and fish-like, with large eyes, swimming up and down the tank.

Fig. 15. *Loligo vulgaris*,
1/2 nat. size. p. 78.

2. **Snails** (p. 78). Sea-hare (*Aplysia*, fig. 16), soft black or brown lumps as large as a man's fist. **Pleurobranchus* (fig. 17). **Umbrella* (fig. 18). Triton's horn (*Tritonium*, fig. 19), with red body and yellow horns banded with

Fig. 16. *Aplysia limacina*,
1/2 nat. size. p. 80.

Fig. 17. *Pleurobranchus testudinarius*,
1/4 nat. size. p. 80.

Fig. 18. *Umbrella mediterranea*,
1/2 nat. size. p. 80.

black; shell pointed, shaped like a whelk; *Tun (*Dolium*, fig. 20), black and white body, rounded shell; *Murex* (fig. 21), much smaller, with spines; Helmet-shell (*Cassis*, fig. 22); *Natica* (fig. 23).

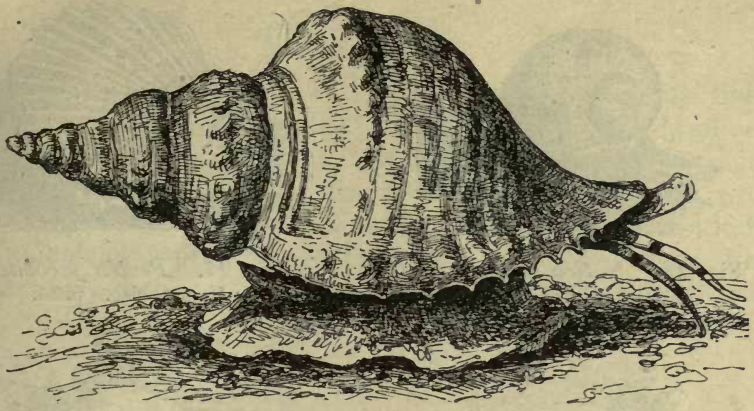


Fig. 19. *Tritonium nodiferum*,
1/3 nat. size. p. 79.

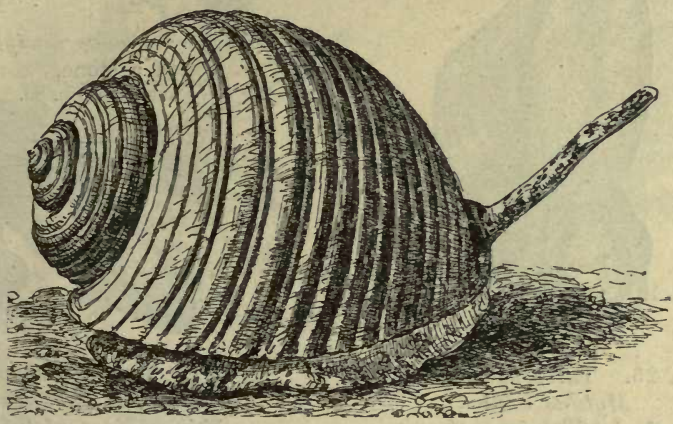


Fig. 20. *Dolium galea*,
1/3 nat. size. p. 79.

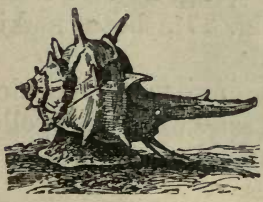


Fig. 21. *Murex brandaris*,
1/2 nat. size. p. 79.

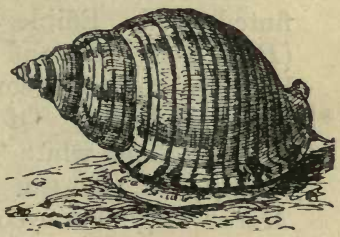


Fig. 22. *Cassis sulcosa*,
1/2 nat. size. p. 79.

Fig. 23. *Natica millepunctata*,
1/2 nat. size. p. 79.

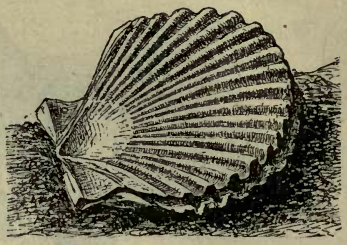


Fig. 24. *Pecten jacobaeus*,
1/2 nat. size. p. 84.

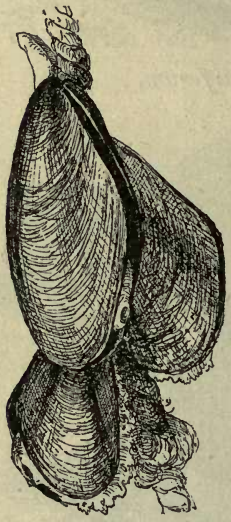


Fig. 25. Three specimens of *Mytilus edulis*,
attached to a piece of rope,
1/2 nat. size. p. 83.

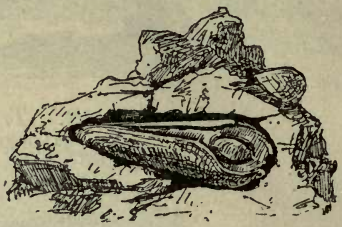


Fig. 26. *Pholas dactylus*,
in a stone,
1/2 nat. size. p. 83.

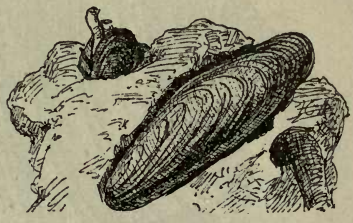


Fig. 27. Two specimens of *Lithodomus dactylus*,
within a piece of tufa,
1/2 nat. size. p. 83.

3. **Bivalves** (p. 81). Scallop (*Pecten*, fig. 24), with flat fluted shell. Edible Mussel (*Mytilus*, fig. 25). Piddock (*Pholas*, fig. 26) and *Lithodomus* (fig. 27), both making holes in rocks or coral reefs.

***Eggs of Mollusks.** Of the squid hanging from the dead coral in long white bags; of the sea-hare fine yellow strings, of the tun ribbons a finger-length broad; of *Murex* large honeycomb-like masses.

The *lettuce sea-weed* serves as food for the sea-hares.

Tank Nr. 4.

Ascidians (Sea-squirts, p. 84). *Ciona* (fig. 28), white half-transparent double tubes. *Phallusia* (fig. 29), knobbed white mass. *Cynthia* (fig. 30), crimson-scarlet, sausage-shaped; the mouths of the two tubes can be seen projecting. Colonies of *Diazona* (fig. 31). Many other kinds. **Tubicolous worms** (see Tank 22), a foot high, like feathery palms. **Fishes.** *Heliases* (fig. 32), small and

Fig. 28.
Four specimens of *Ciona intestinalis*,
1/2 nat. size. p. 84.

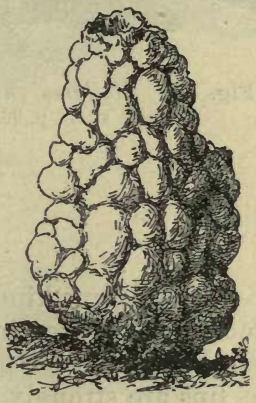


Fig. 29.
Phallusia mammillata,
1/2 nat. size. p. 85.

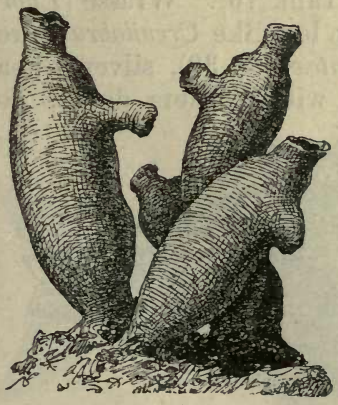


Fig. 30. Four specimens of
Cynthia papillosa,
1/2 nat. size. p. 84.

Fig. 31.
A colony of *Diazona violacea*,
1/3 nat. size. p. 85.

black, with deeply forked tail. **Apogon* (fig. 33), red, only in summer.

Sea-weeds. Red algæ (*Sebdenia* and *Vidalia*), like withered beech-leaves. Green alga (*Codium bursa*), dark green balls, the size of a marble to that of a melon.

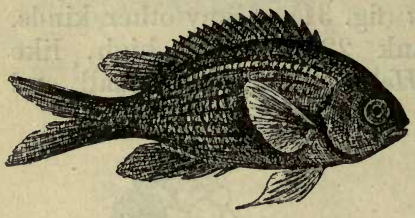


Fig. 32. *Heliases chromis*, 1/2 nat. size. p. 96.

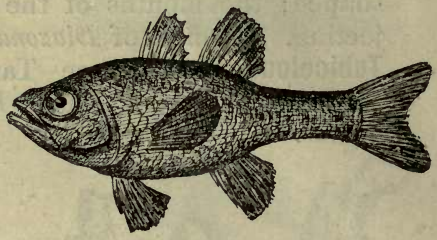


Fig. 33. *Apogon rex mullorum*, 1/2 nat. size. p. 96.

Tank Nr. 5.

About ten kinds of **Fishes** continuously swimming. Among these prominent by colour or otherwise: Peacock-wrasse (*Crenilabrus pavo*, fig. 34), with blue fins and tail, the lips are strongly turned outwards. Sea-bream (Snapper, *Pagellus*, fig. 37), a delicate coral-pink. Gilt-head (*Chrysophrys*, fig. 38), silver, a black smudge on each side behind its head. (Larger specimens in Tank 10). Wrasse (*Labrus*, fig. 35 and 36), shaped more or less like *Crenilabrus*, green or mottled. Toothed-bream (*Dentex*, fig. 39), silvery, heavy nose, eyes high, straight mouth with corners down, noti-

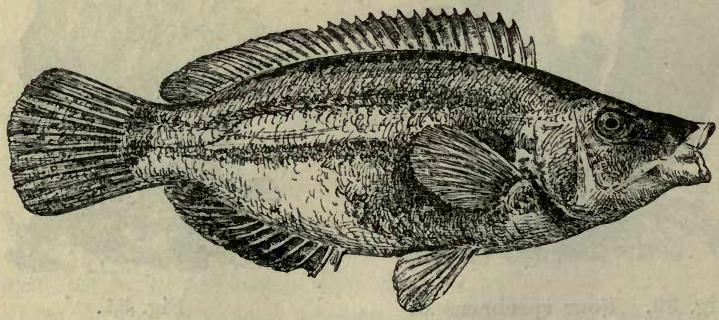


Fig. 34. *Crenilabrus pavo*, 1/2 nat. size. p. 96.

ceably sullen and aggressive expression. Black Bream (*Cantharus*, fig. 40), bluish, with short mouth. Sar (*Sargus*, fig. 41), fins with dark edges. *Umbrina* (fig. 42), dark with light undulating stripes.

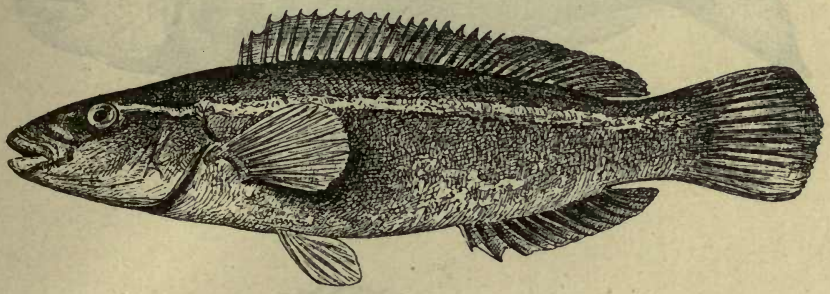


Fig. 35. *Labrus festivus*,
1/2 nat. size. p. 96.

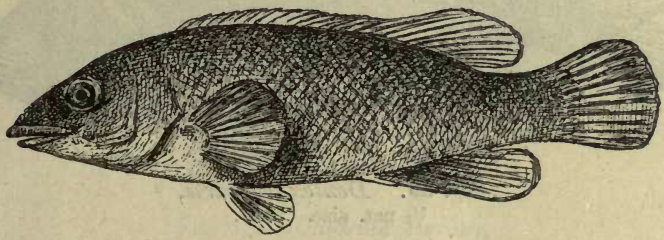


Fig. 36. *Labrus merula*,
1/2 nat. size. p. 96.

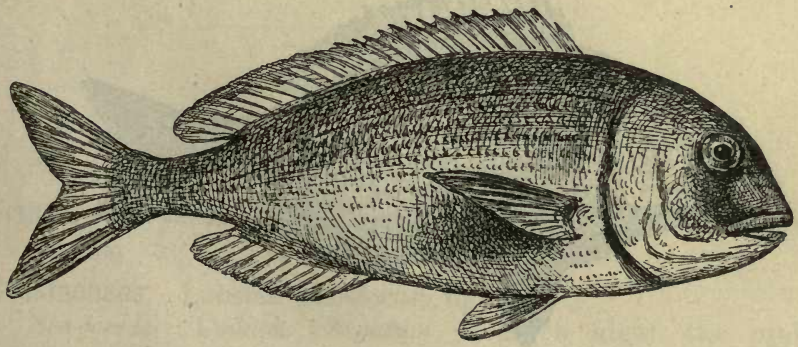


Fig. 37. *Pagellus erythrinus*,
1/2 nat. size. p. 97.

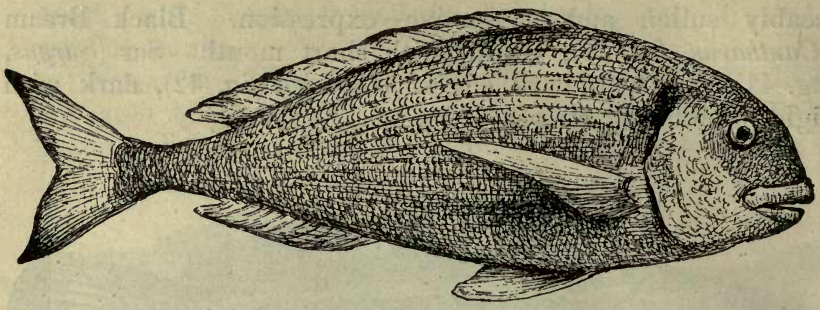


Fig. 38. *Chrysophrys aurata*,
1/3 nat. size. p. 97.

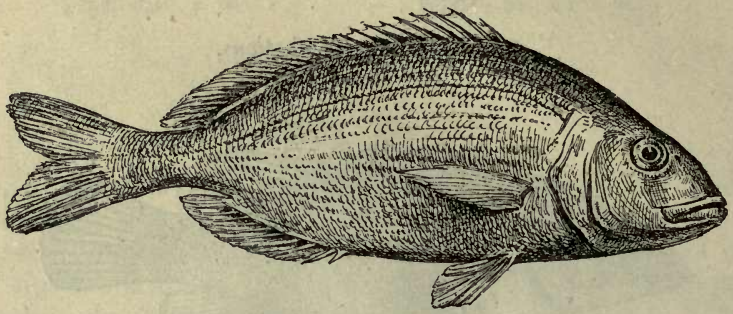


Fig. 39. *Dentex vulgaris*,
1/3 nat. size. p. 97.

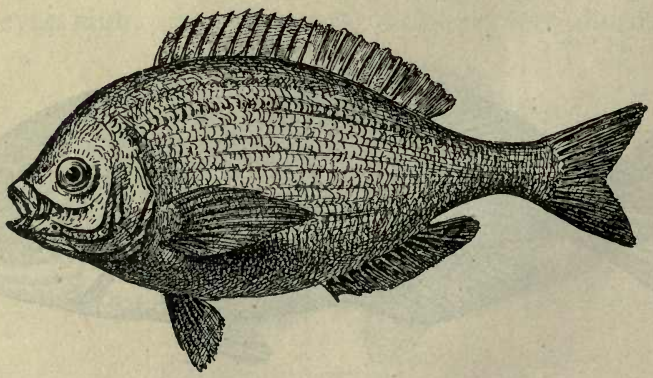


Fig. 40. *Cantharus vulgaris*,
1/2 nat. size. p. 97.

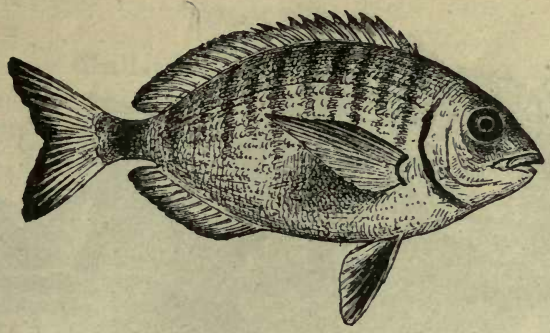


Fig. 41. *Sargus Rondeletii*,
1/3 nat. size. p. 97.

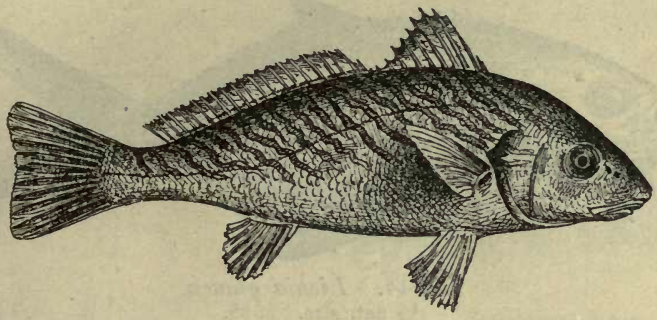


Fig. 42. *Umbrina cirrosa*,
1/3 nat. size. p. 97.

Tank Nr. 6.

Fishes. *Scorpaena* (fig. 43), ragged and red, with red eyes. **Lichia* (fig. 44), a small kind of mackerel.

Crustaceans. Lobster (*Homarus*, fig. 45).

Sea-weeds. *Codium elongatum* (a green alga); the pink stone-like balls are calcareous sea-weeds (Corallinæ, cp. tank 21).

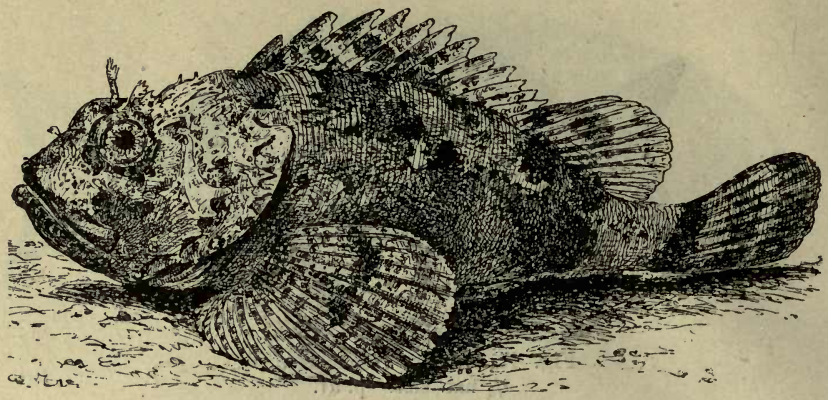


Fig. 43. *Scorpaena porcus*,
1/2 nat. size. p. 92.

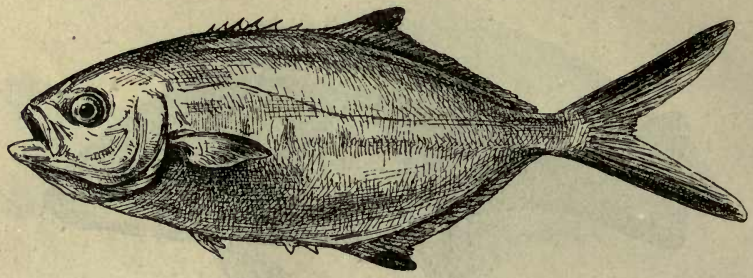


Fig. 44. *Lichia glauca*,
1/2 nat. size. p. 98.

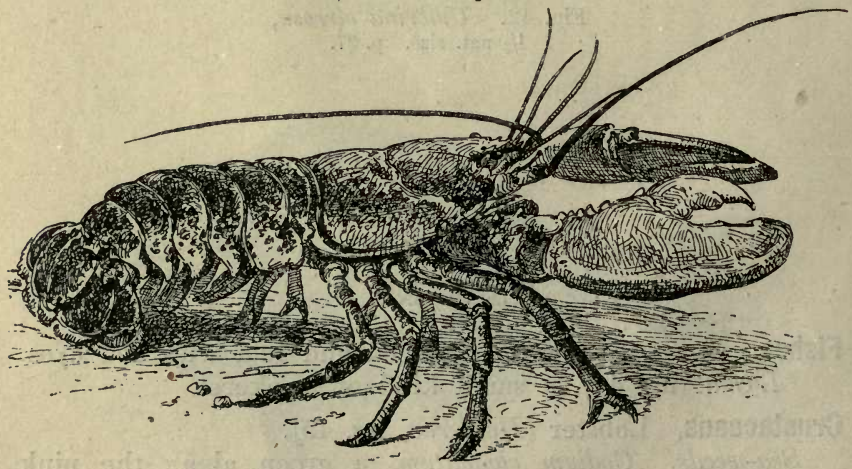


Fig. 45. *Homarus vulgaris*,
1/3 nat. size. p. 68.

Tank Nr. 7.

Fishes. Grey Mullet (*Mugil*, fig. 46), slender and silvery, the underlip shaped like a W.

Crustaceans (p. 68). Crawfish or Spiny-lobster (*Palinurus*, fig. 48), like a lobster without pinching claws. Spider-

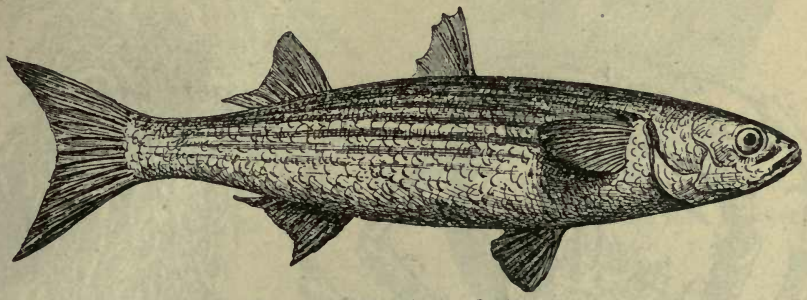


Fig. 46. *Mugil cephalus*,
1/2 nat. size. p. 97.

Fig. 47. *Scyllarus latus*,
1/3 nat. size. p. 70.

Fig. 48. *Palinurus vulgaris*,
1/3 nat. size. p. 70.

crab (*Maja*, fig. 49), a pear-shaped body in the middle of ten legs. Note the constant movements of the eyes, feelers and mouth parts. Flat-lobster (*Scyllarus*, fig. 47), lobster-like with short flat legs and claws.

Sea-weeds. On the walls is a purple velvet-like covering.

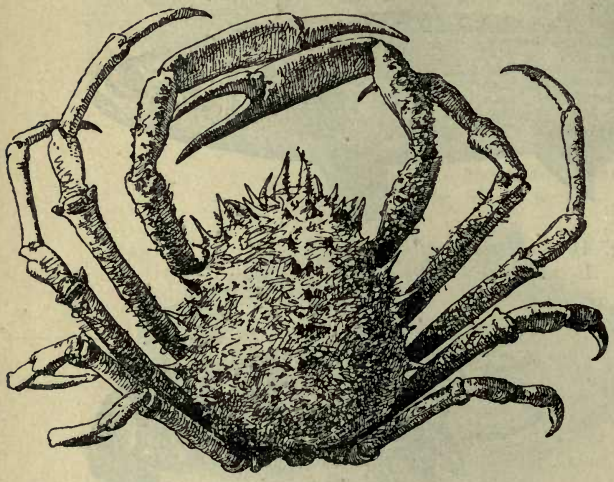


Fig. 49. *Maja squinado*, ½ nat. size. p. 73.

Fig. 50. *Anemonia sulcata*, ½ nat. size. On the right is the rock to which it is attached. p. 57.

Tank Nr. 8.

Sea-anemones (p. 56). The larger ones are *Anemonia* (fig. 50).

Tank Nr. 9.

Sea-anemones. In the foreground (isolated) the crimson-purple *Cereactis* (fig. 51), and other kinds.

Corals. In the background the orange-coloured *Astroides* (fig. 52), often like slugs.

Fishes. *Cuckoo (*Capros*, fig. 53), oval red little fish. *Trumpeter (*Centriscus*, fig. 54), with long snout and back-fin.

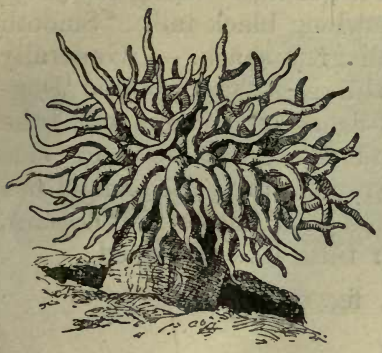


Fig. 51. *Cereactis aurantiaca*, projecting out of the sand, 1/2 nat. size. p. 57.

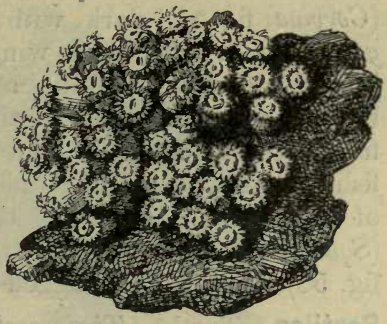


Fig. 52. Colony of *Astroides calycularis*, 1/2 nat. size. On the right is the rock to which it is attached. p. 57.

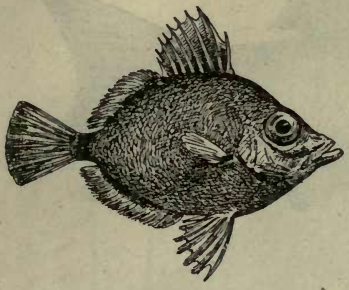


Fig. 53. *Capros aper*, 1/2 nat. size. p. 98.

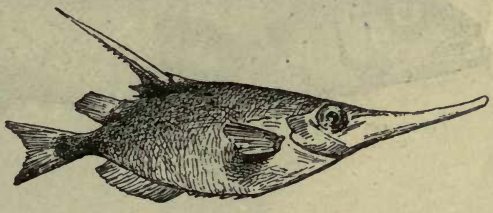


Fig. 54. *Centriscus scolopax*, 1/2 nat. size. p. 98.

Tank Nr. 10.

It contains the large kinds of **Fishes.** Among these are to be noticed: *Conger (*Conger*, fig. 61), conspicuous, if present, four or five feet long and eel-shaped. Bass (*Labrax*, fig. 55), salmon-shaped, with silver scales. Gilt-head (*Chrysophrys*, fig. 38), oval and blunt-headed, with white marks over the eyes (effect of light in this tank) and black splotches on the side of the neck (see tank 5). *Serranus gigas* (fig. 56), heavy, often motionless for a long time, in mid-water, and frequently in a characteristic sloping position; reddish brown, mottled white, no silver. Sea-crow

(*Corvina*, fig. 57), dark, with dark lower fins. *Sting-ray (*Trygon*, fig. 62), with black wings and long black tail. *Smooth hound (*Mustelus*, fig. 60), a small grey shark. — Generally heaped on the bottom against the glass are Spotted Dogfish (*Scyllium*, fig. 59). The dog-fishes and sharks are lithe fishes with the mouth under and five gill-holes each side of the neck. Flat on the ground are the Angel-fish (*Squatina*, fig. 63), big and grey, and the *Angler-fish (*Lophius*, fig. 58), brown and ragged with tufts like sea-weed.

Reptiles. Turtle (*Thalassochelys*, fig. 64).

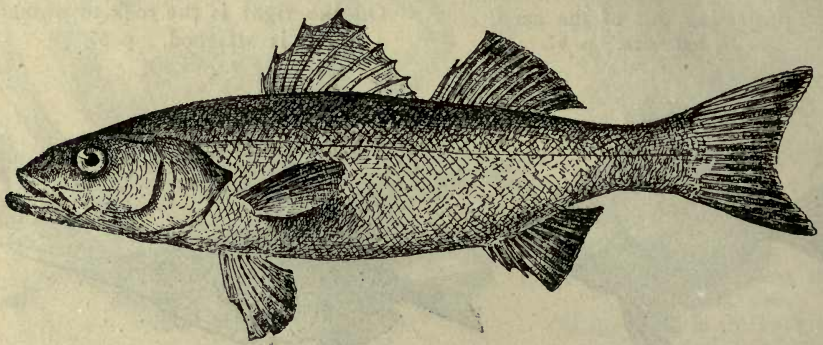


Fig. 55. *Labrax lupus*,
1/6 nat. size. p. 96.

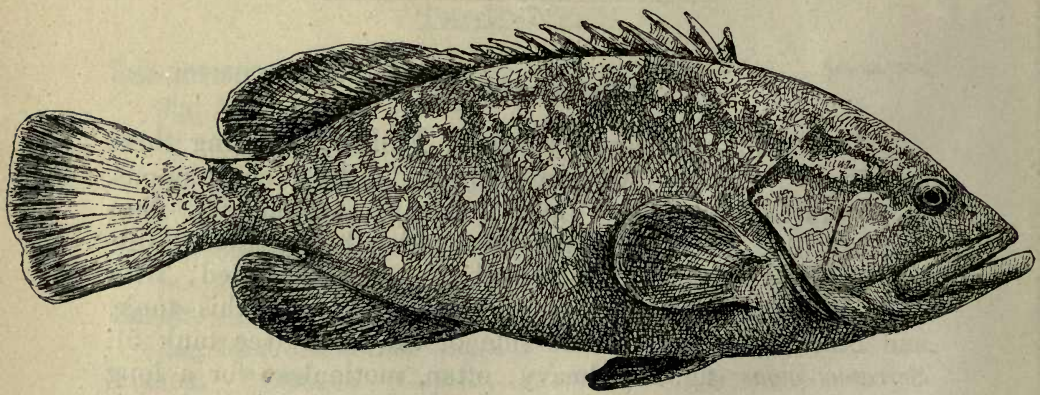


Fig. 56. *Serranus gigas*,
1/4 nat. size. p. 96.

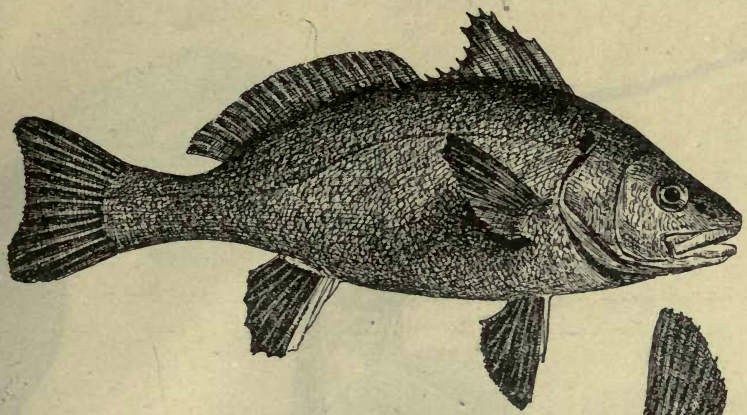


Fig. 57. *Corvina nigra*,
1/3 nat. size. p. 97.

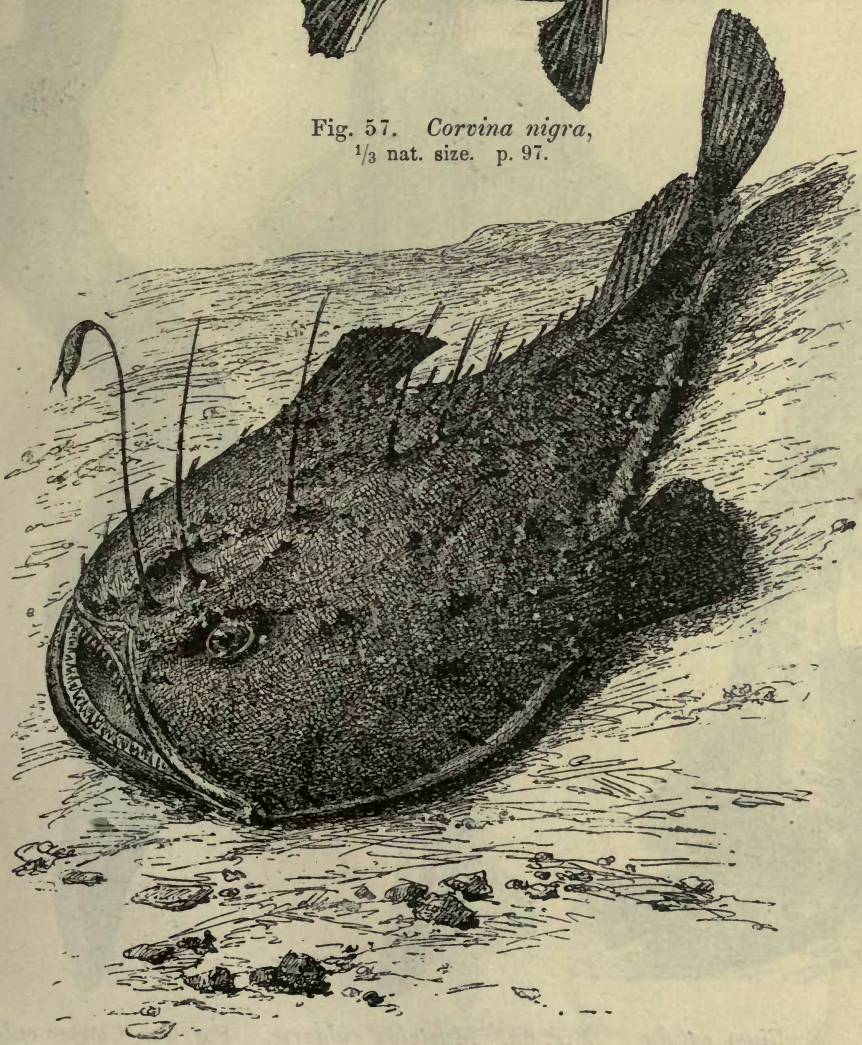


Fig. 58. *Lophius piscatorius*,
1/3 nat. size. p. 91.

Fig. 59. *Scyllium catulus*, 1/6 nat. size. p. 89.

Fig. 60. *Mustelus vulgaris*, 1/6 nat. size. p. 89.

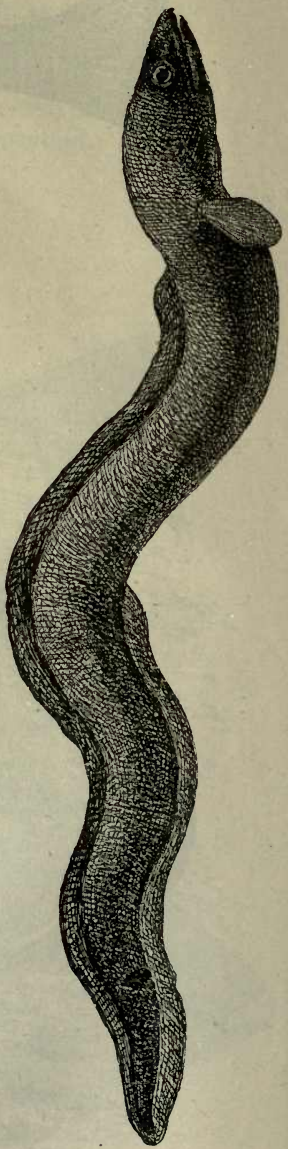


Fig. 61. *Conger vulgaris*, 1/5 nat. size. p. 94.

Fig. 62. *Trygon violaceus*,
1/5 nat. size. p. 90.

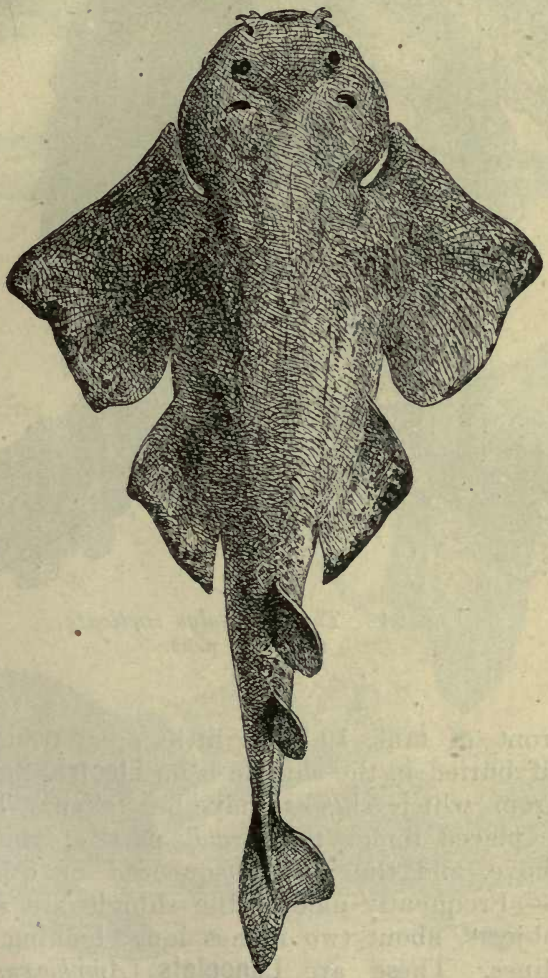


Fig. 63. *Squatina angelus*,
1/10 nat. size. p. 90.

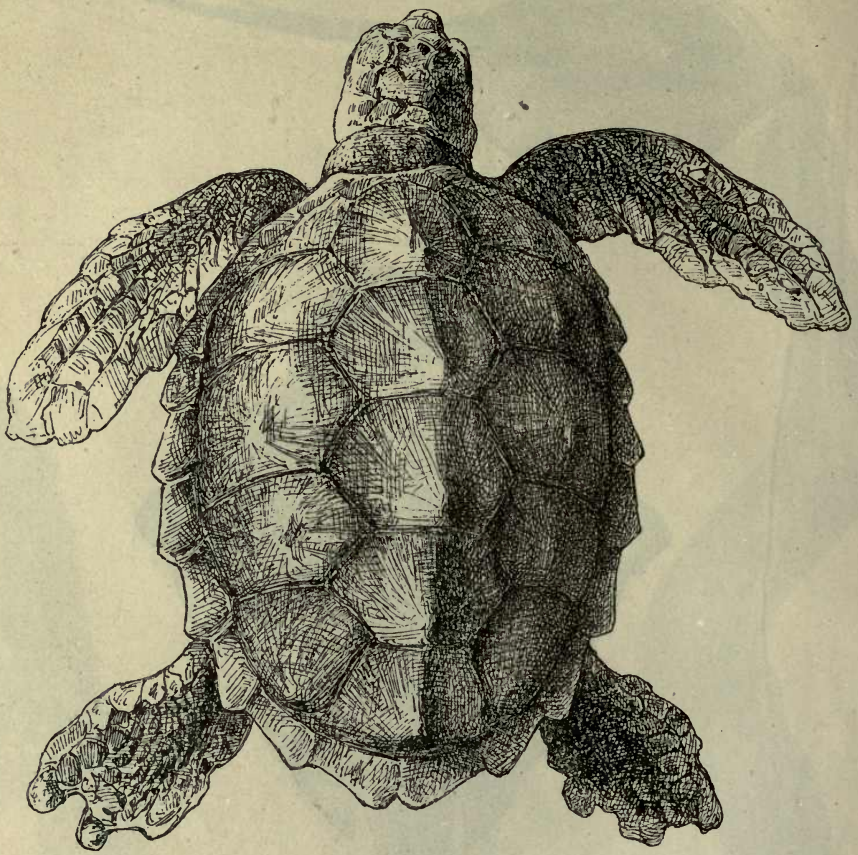


Fig. 64. *Thalassochelys corticata*,
1/5 nat. size. p. 99.

In front of tank 10 is a little open trough. Lying on or half buried in the shingle is an **Electric Ray** (*Torpedo*, fig. 65) from which shocks may be taken. The fingers should be placed under the broad part of the body, the thumb above, and the animal squeezed or otherwise ill-treated. — Frequently among the shingle are small white pointed objects, about two inches long, looking not unlike split sardines. These are **Lancelets** (*Amphioxus*, fig. 66), the lowest Vertebrate.

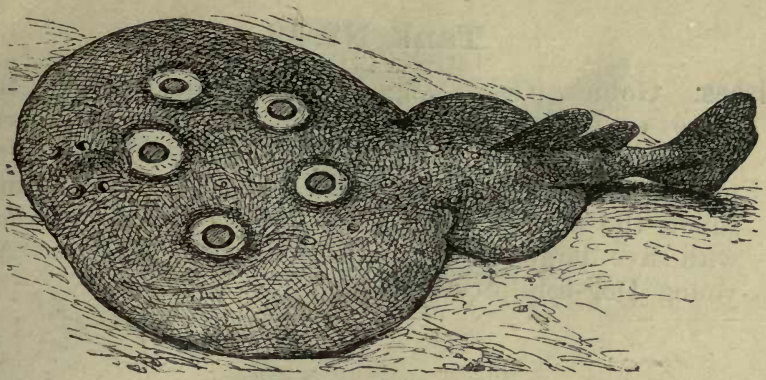


Fig. 65. *Torpedo ocellata*,
1/3 nat. size. p. 90.

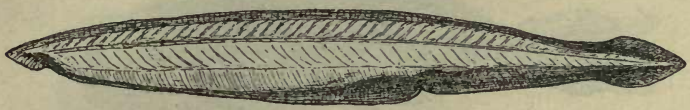


Fig. 66. *Amphioxus lanceolatus*,
twice nat. size. p. 87.

Tank Nr. 11.

Fishes. Coiling among old pottery both the Roman Eel (*Muraena*, fig. 67), with fine markings, and the Conger (*Conger*, fig. 61), dark-coloured.

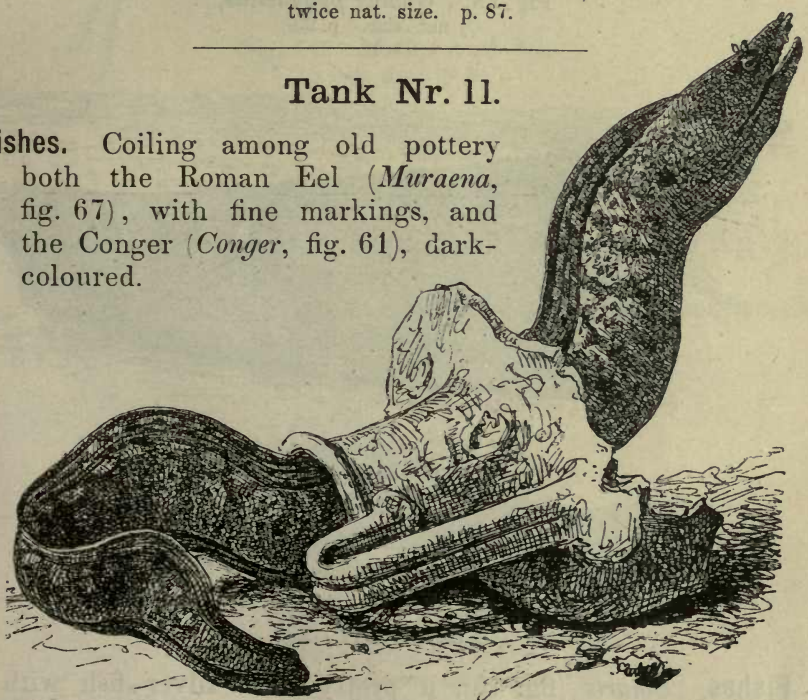


Fig. 67. *Muraena helena*,
1/4 nat. size. p. 94.

Tank Nr. 12.

Fishes. Gobies (*Gobius*, fig. 68), small and spiny; they serve as food for Skates (*Raja*, fig. 69) and Electric Rays (*Torpedo*, fig. 65). Both of these are flat and nearly hidden in the sand; the skate grey with pointed snout, the electric ray brown, in one species (*ocellata*) with five large spots, its head is semi-circular. Also young Dog-fish (*Scyllium*, fig. 59).

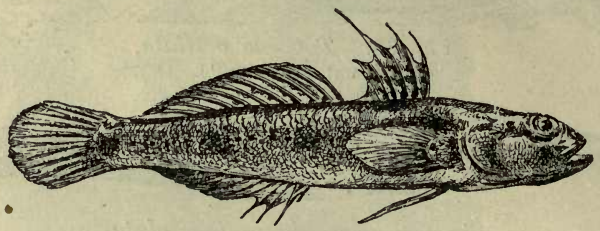


Fig. 68. *Gobius paganellus*,
1/2 nat. size. p. 93.

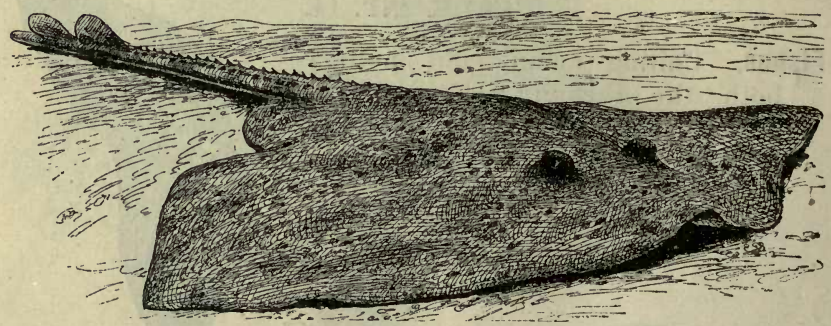


Fig. 69. *Raja punctata*,
1/3 nat. size. p. 90.

Tank Nr. 13.

Fishes. *Smaris* (fig. 70), a pretty little silver fish with a black finger-mark on each side. Red Mullet (*Mullus*, fig. 71), with two white feelers in front of its chin.

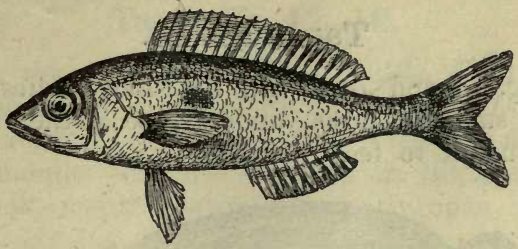


Fig. 70. *Smaris alcedo*,
1/2 nat. size. p. 97.

Fig. 71. *Mullus barbatus*,
1/2 nat. size. p. 94.

Tank Nr. 14.

Fishes. Small kinds of *Serranus*, e. g. Lettered-perch (fig. 72), with cross-bands of brown and silver.

The plants (*Posidonia Caulini*) are not true sea-weeds (Algæ) but a kind of flowering plant.

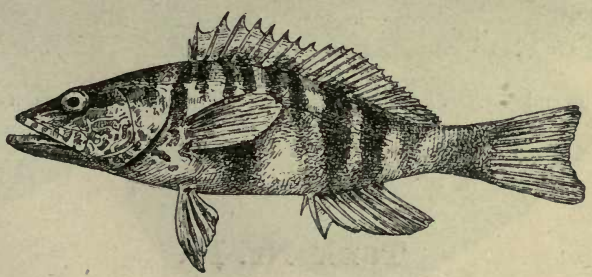


Fig. 72. *Serranus scriba*,
1/2 nat. size. p. 96.

Tank Nr. 15.

Octopus (fig. 73 and 74), with toad-like bodies and eight twisted, suckered arms; under these is the mouth. Ask the attendant to feed them.

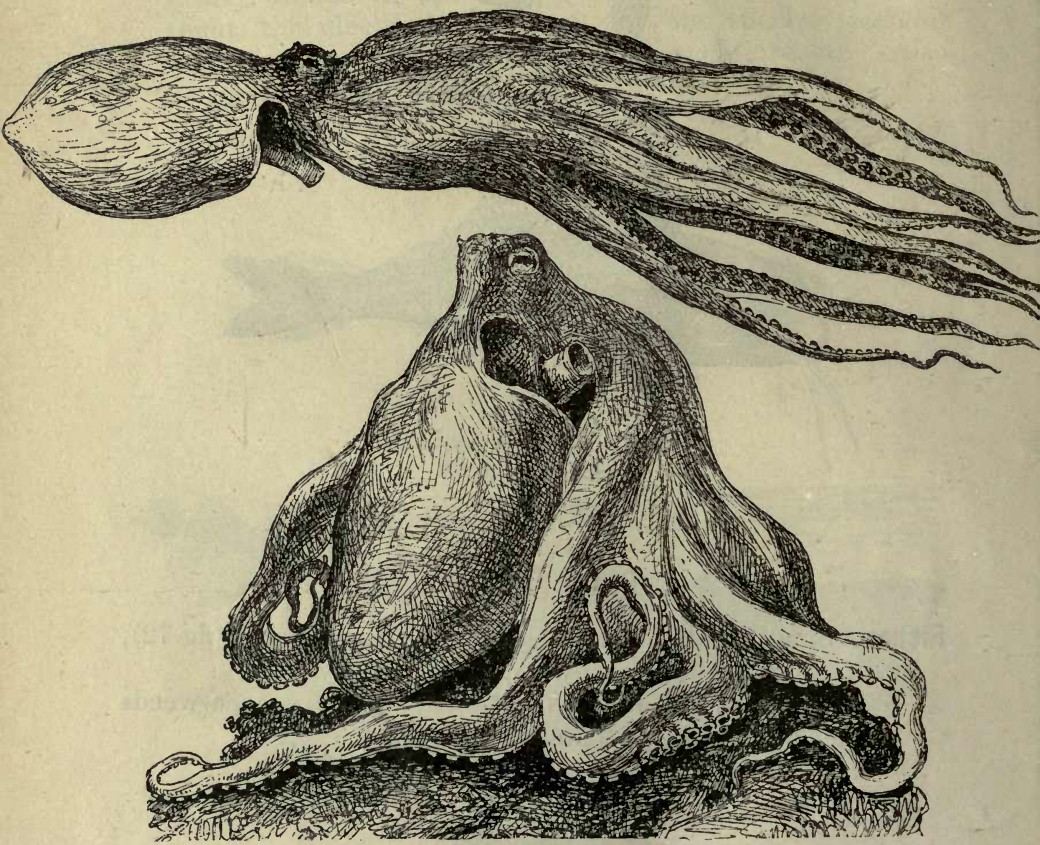


Fig. 73 and 74. *Octopus vulgaris*, swimming and on a stone, 1/3 nat. size. p. 76.

Tank Nr. 16.

Fishes. Grey Mullet (*Mugil*, fig. 46).
Also young **Octopus** (fig. 73 and 74).

Tank Nr. 17, 18.

Fishes. On the sand the Gurnard (*Trigla*, fig. 75), walking on six fingers (fin-spines). *Flying Gurnard (*Dactylopterus*, fig. 77), reddish, with large great wing-like fins. In the warmer months *File-fish (*Balistes*, fig. 76), oval, smudged with black, mouth always apparently open, teeth projecting.

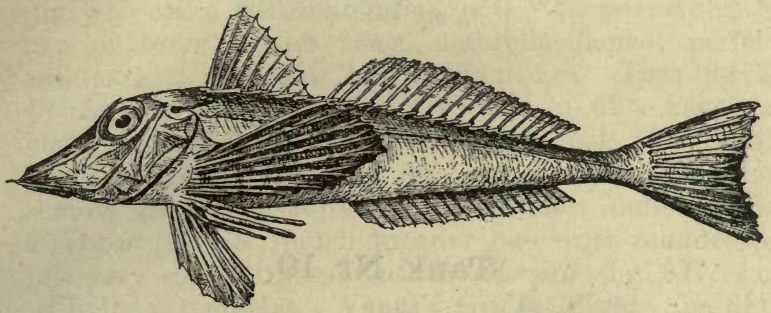


Fig. 75. *Trigla lyra*.
1/2 nat. size. p. 93.

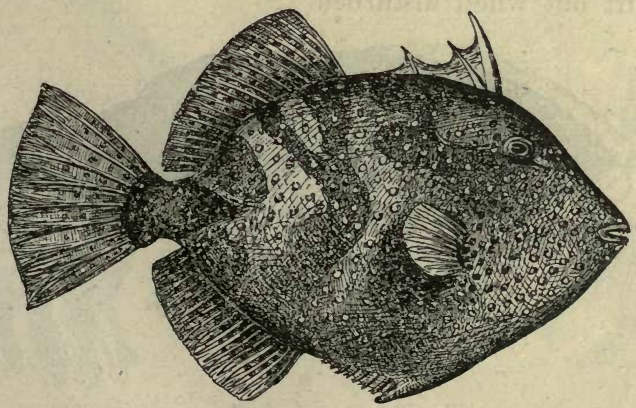


Fig. 76. *Balistes capriscus*,
1/2 nat. size. p. 98.

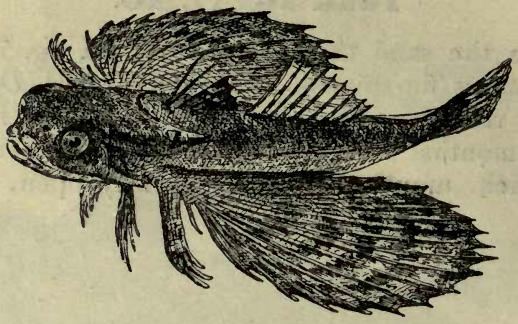


Fig. 77. *Dactylopterus volitans*,
1/3 nat. size. p. 93.

Tank Nr. 19.

Cuttlefish (*Sepia*, fig. 78). Four to ten inches long and half as broad, in shape like a small, big-headed, heavily made fish. They may be floating, but generally lie in corners on the sand, which they resemble in colour. The dirty colour of the water is due to the ink they squirt out when disturbed.

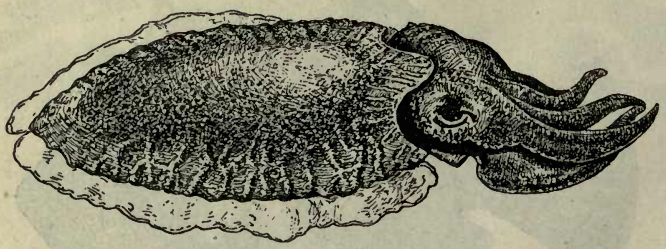


Fig. 78. *Sepia officinalis*,
1/2 nat. size. p. 77.

Tank Nr. 20.

Pelagic Animals (see Note on p. 62). These show best in bright sunshine (from noon to two); many do not live long, and the tank is richest after a calm dull day. The more delicate are in wide glass cylinders. There may be:

Jelly fish. A. Medusae (p. 60). *Cotylorhiza* (fig. 80, from September to January), nearly a foot across, like a mushroom growing from an inverted cauliflower. *Rhizostoma* (fig. 79), as large, a beautiful white globe with a violet border and a swelling violet and white stalk. *Pelagia* (fig. 81) white with numerous spots. *Carmarina* (fig. 83), two or three inches long, umbrella-shaped, perfectly transparent, with four long fishing-lines. *Tima* (fig. 82). *Olindias* (fig. 84). B. Ctenophora (p. 62), have each eight lines of moving paddles which look like running beads of light. *Beroë* (fig. 86), one to three inches long, shaped like a bishop's mitre; a most delicate pink. *Eucharis* (fig. 85), much broader base with rounded projections, quite transparent. *Callianira* (fig. 87), small with long tentacles. Venus's Girdle (*Cestus*, fig. 88), a transparent ribbon about an inch broad. C. Siphonophora (p. 61), generally like transparent filmy flowers on a central stalk: *Physophora* (fig. 89), *Forskalia* (fig. 92), *Velella* (fig. 91), *Hippopodius* (fig. 90), etc.

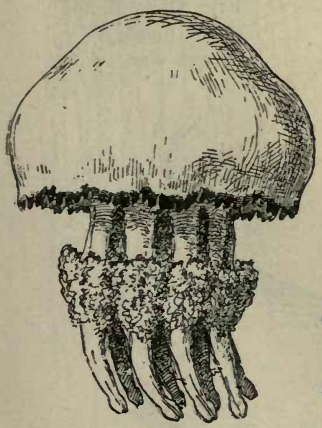


Fig. 79. *Rhizostoma pulmo*, small specimen. p. 60.

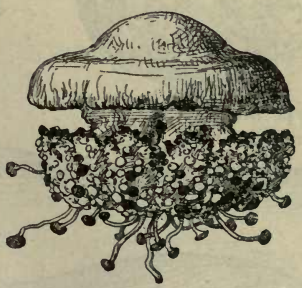


Fig. 80. *Cotylorhiza borbonica*, 1/2 nat. size. p. 60.

Fig. 81. *Pelagia noctiluca*, 1/3 nat. size. p. 60.

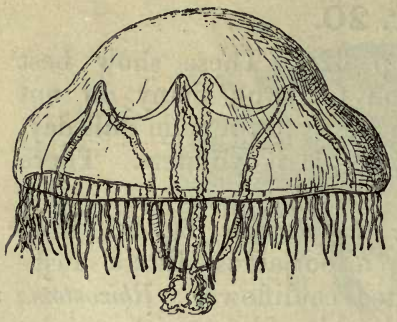


Fig. 82. *Tima flavilabris*,
1/2 nat. size. p. 60.

Fig. 83. *Carmarina hastata*,
1/2 nat. size. p. 60.

Fig. 84. *Olindias Müllerii*,
1/2 nat. size. p. 60.

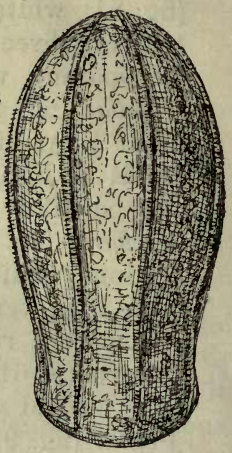


Fig. 86. *Beroë ovata*,
1/2 nat. size. p. 63.

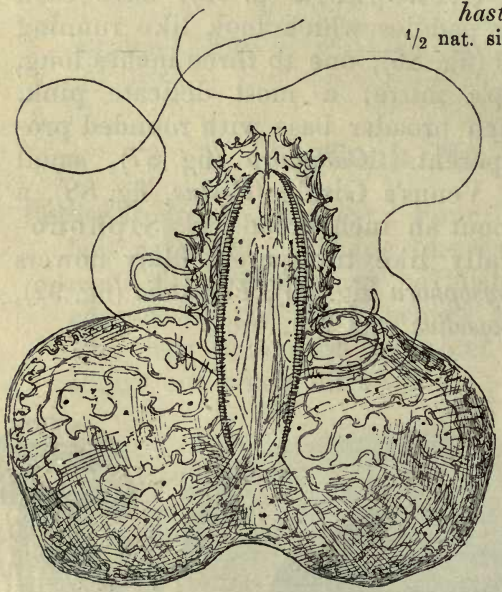


Fig. 85. *Eucharis multicornis*,
1/2 nat. size. p. 63.

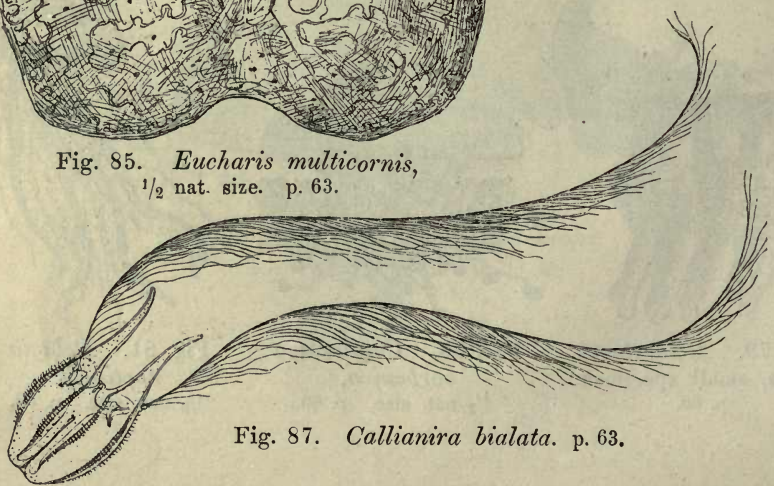


Fig. 87. *Callianira bialata*. p. 63.

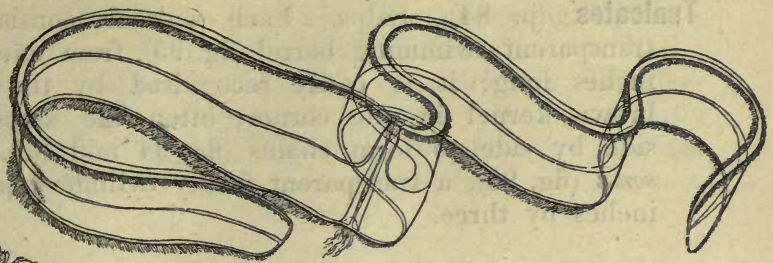


Fig. 88. *Cestus Veneris*,
1/2 na t. size. p. 63.

Fig. 92. *Forskalia contorta.*
p. 62.

Fig. 89. *Physophora hydrostatica*,
1/2 nat. size. p. 62.

Fig. 90. *Hippopodius neapolitanus.*
p. 62.

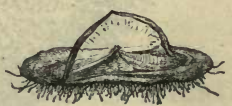


Fig. 91. *Velella spirans.*
p. 62.

Tunicates (p. 84). Salps. Each animal consists of a transparent swimming barrel (fig. 93), from one to eight inches long; it is easily recognised by the globular brown kernel in one corner; often the salps adhere side by side to form chains (fig. 94 and 95). **Pyrosoma* (fig. 96), a transparent frothy cylinder up to eight inches by three.

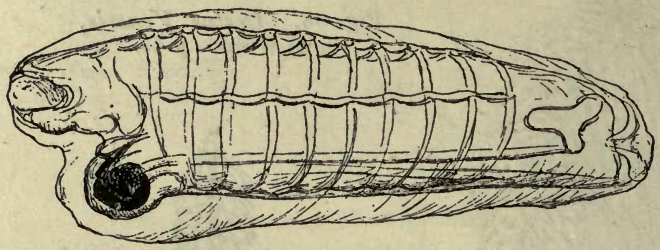


Fig. 93. Single individual of *Salpa maxima-africana*, 1/2 nat. size. p. 86.

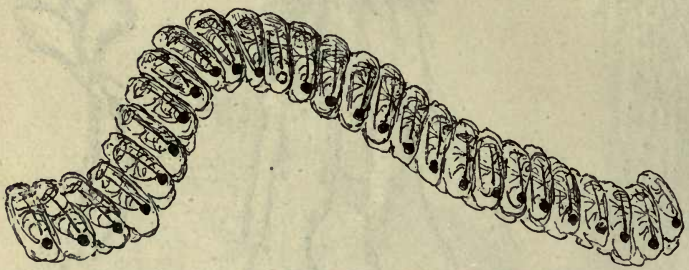


Fig. 94. Chain of *Salpa maxima-africana*, 1/2 nat. size. p. 86.

Fig. 95. Chain of *Salpa pinnata*, 1/2 nat. size. p. 86.

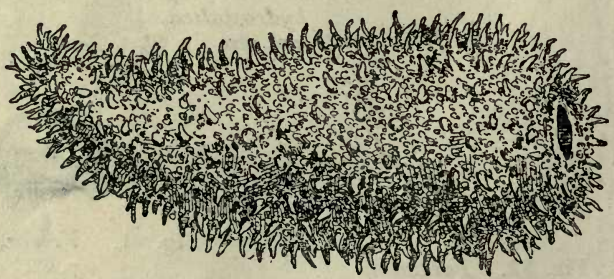


Fig. 96. *Pyrosoma elegans*, 1/2 nat. size. p. 85.

Mollusks. A. Heteropods (p. 81). *Pterotrachea* (fig. 97) has a long proboscis and sculls itself rapidly on its back; somewhat similar is the allied *Carinaria* (fig. 98), less transparent and with a small shell. B. Pteropods (Sea-butterflies, p. 81), flap a pair of transparent wings (*Hyalaea*, fig. 99).

Fig. 97. *Pterotrachea coronata*, 1/2 nat. size. p. 81.

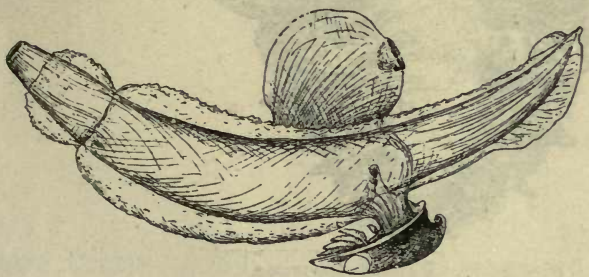


Fig. 98. *Carinaria mediterranea*, 1/2 nat. size. p. 81.

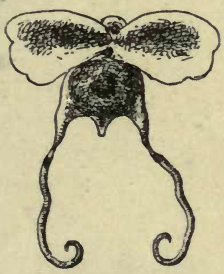


Fig. 99. *Hyalaea tridentata*. p. 81.

Besides these pelagic animals there are outside the cylinders various small *Octopods* (p. 76), and crawling Mollusks, such as **Tethys* (fig. 101), as large as a hand, spotted with red and brown, **Doris* (fig. 100), as large as a thumb, a tuft at one end, **Aeolis* (fig. 102), etc. Of **Crustaceans** various kinds of shrimps (see Tank Nr. 23).

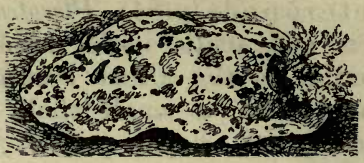


Fig. 100. *Doris tuberculata*,
1/2 nat. size. p. 81.

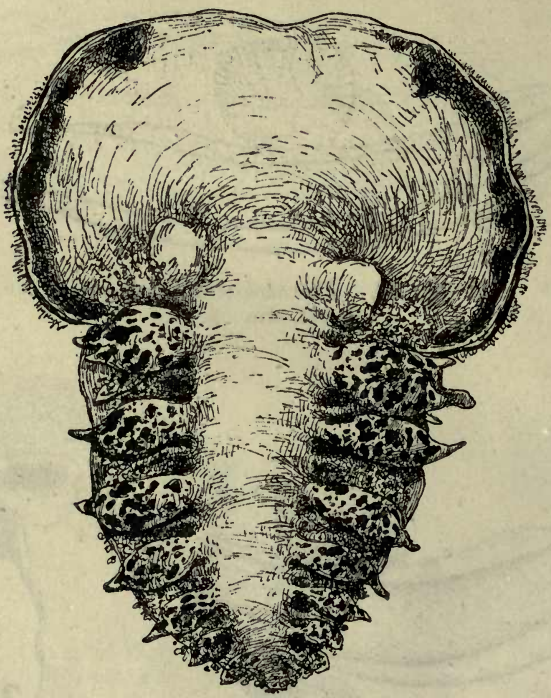


Fig. 101. *Tethys leporina*,
1/2 nat. size. p. 80.

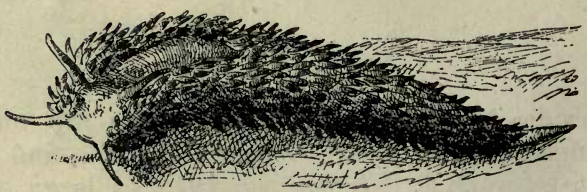


Fig. 102. *Aeolis papillosa*.
p. 81.

Tank Nr. 21.

Fishes. Pipe-fish (*Syngnathus*, fig. 103), long thin body, something like a sea-horse straightened out. *On a dead *Gorgonia*-stem young Dog-fish (p. 89) in the egg.

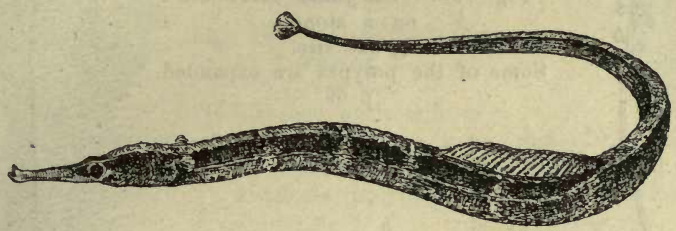


Fig. 103. *Syngnathus acus*,
1/2 nat. size. p. 95.

Hard Corals (p. 59). Sea-fan (*Gorgonia*, fig. 105), fan-like red branches in back-ground. Black Coral (*Antipathes*, fig. 107), an even black stem, the thickness of a boot-lace, with very fine branches. Red Coral (*Corallium*, fig. 106, the coral used in jewellery), in a glass bottle. White Coral (*Isis*, fig. 104). The thickish grey branches with bright yellow tops are *Dendrophyllia* (fig. 109). **Fleshy Corals** (p. 58). On the bottom, pink and white branches, thicker than the last named, is "Dead-men's-fingers" (*Alcyonium*, fig. 108); pink, like a swollen ostrich plume, the Sea-pen (*Pennatula*, fig. 110). **Sea-anemones.** *Alicia* (fig. 111).

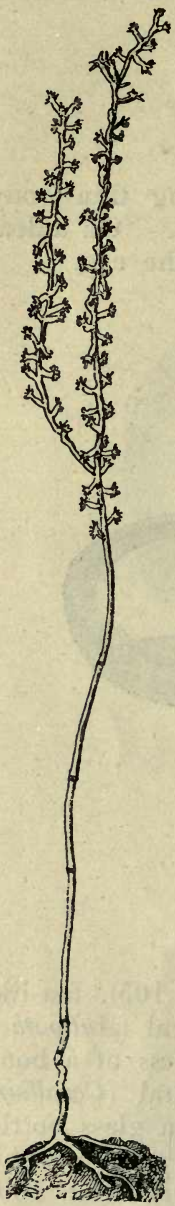


Fig. 104. *Isis neapolitana* on a stone, with expanded polypes.
The bark has died off at the lower end and the skeleton is therefore visible.
1/2 nat. size. p. 59.

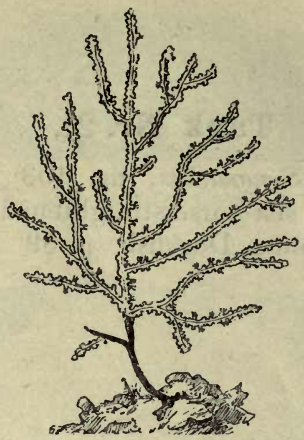


Fig. 105. *Gorgonia verrucosa* on a stone,
1/2 nat. size.
Some of the polypes are expanded.
p. 59.

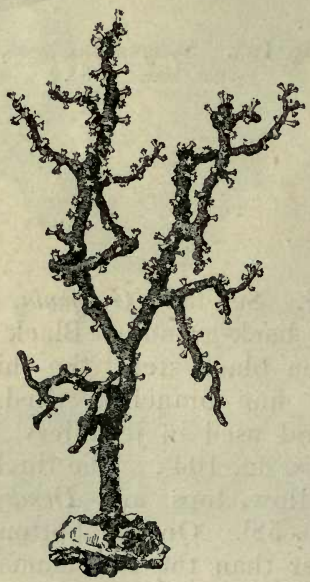


Fig. 106. *Corallium rubrum* on a stone, with expanded polypes,
1/2 nat. size. p. 59.

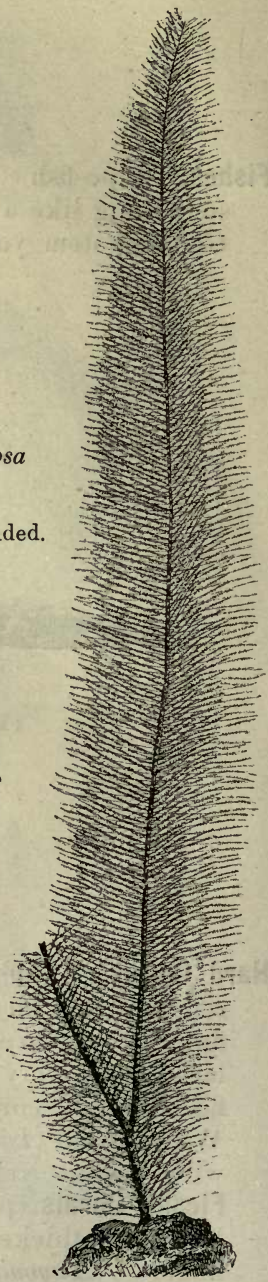


Fig. 107. *Antipathes larix* attached to a stone,
1/2 nat. size. p. 59.

Fig. 108. *Alcyonium palmatum* with expanded polypes, $^1/_2$ nat. size. p. 58.

Fig. 109. *Dendrophyllia ramea*, $^1/_2$ nat. size. The branch projects from a stone and bears two living and three dead individuals (polypes). p. 58.

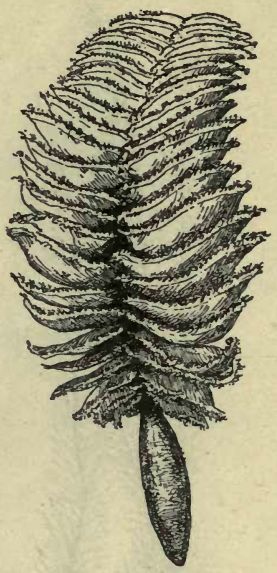


Fig. 110. *Pennatula phosphorea* in extended condition, $^1/_2$ nat. size. p. 58.

Fig. 111. *Alicia Costae* attached to a stone, $^1/_2$ nat. size. p. 57.

Hydroid-polypes (p. 61). Delicate soft feathery tufts: *Antennularia* (fig. 112); *Aglaophenia* (fig. 113); *Pennaria* (fig. 114); *Tubularia* (fig. 115).

Fig. 112. *Antennularia antennina.* p. 61.

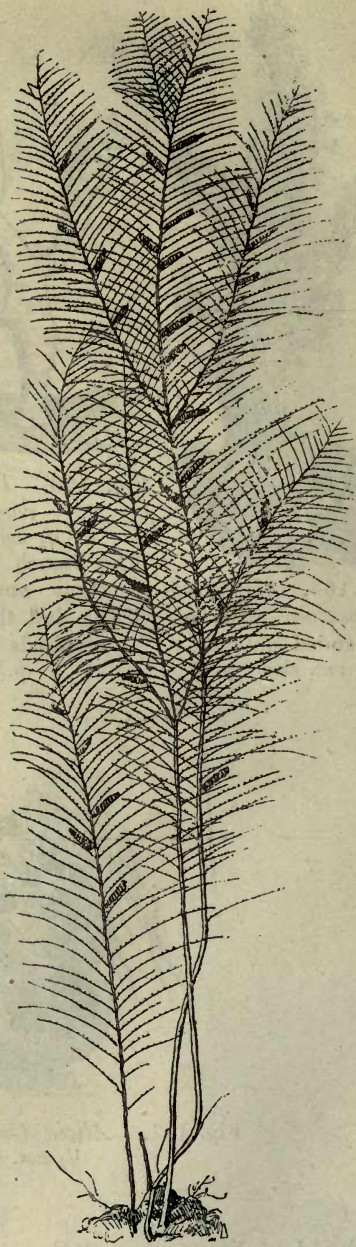


Fig. 113. *Aglaophenia myriophyllum,* 1/2 nat. size. p. 61.

Fig. 114. *Pennaria Cavolinii.* p. 61.

Fig. 115. *Tubularia larynx.* p. 61.

Polyzoa (p. 68). *Retepora* (fig. 116); *Myriozoum* (fig. 117).

Fig. 116. *Retepora cellulosa,* 1/2 nat. size. p. 68.

Fig. 117. *Myriozoum truncatum,* 1/2 nat. size. p. 68.

Siliceous Sponges (p. 55). *Tethya* (fig. 119), on the sand, like a rough Tangierine orange. *Axinella* (fig. 120), red branches, thicker and more irregular than the coral *Gorgonia.* Other kinds, white, brown or pink, bowl-shaped or finger-shaped, on the rocks. **Horny Sponges.** The Toilet-sponge (*Euspongia*, fig. 118), inconspicuous, grey or brown colour, velvety surface, a few large holes; generally in the front of the tank.

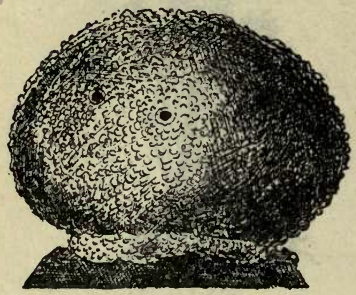


Fig. 118. *Euspongia officinalis* attached to a stone. In its living state, 1/3 nat. size. p. 55.

Fig. 119. *Tethya lyncurium* on a stone. p. 55.

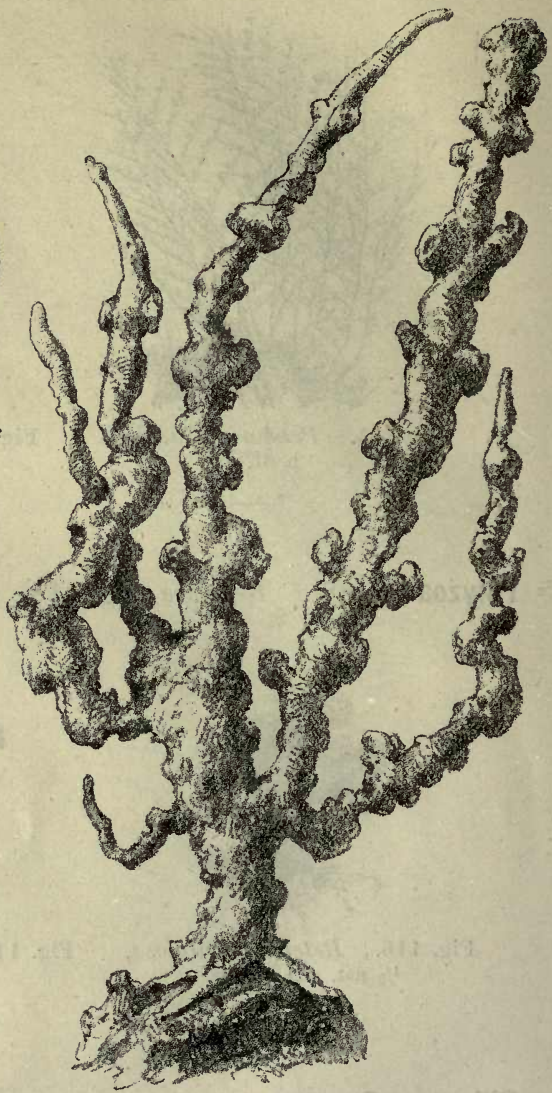


Fig. 120. *Axinella* on a stone, 1/2 nat. size. p. 55.

Sea-weeds. Red algæ: *Vidalia*, brown fronds; the flat, thin, pink and white, hard Corallinæ (calcareous); Green algæ: *Codium*, dark green balls; *Valonia*, glistening green balls like bubbles; *Halimeda*, cactus-like green jointed plants (calcareous.)

Tank Nr. 22.

Ringed Worms (p. 66). Palm-like tube-inhabiting worms (*Spirographis*, fig. 121). The red feathers on coiling white tubes are *Protula* (fig. 122). Also other kinds (*Hydroides*, fig. 124, etc.). Sea-mouse (*Aphrodita*, fig. 123), crawling on the sand.

Fig. 123. *Aphrodita aculeata*, 1/2 nat. size. p. 67.

Fig. 121. *Spirographis Spallanzanii*, 1/2 nat. size. p. 66.

Fig. 122. *Protula intestinum*, 1/2 nat. size. p. 66.

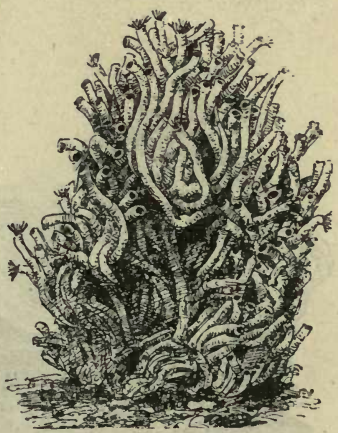


Fig. 124. *Hydroides uncinata*. p. 66.

Mollusks. Worm-shell (*Vermetus*, fig. 125), resembling the worm *Protula*, but easily distinguishable by its two feelers. Ear-shell (*Haliotis*, fig. 126), on the sand. Bivalves: as Oysters (*Ostrea*, fig. 127), *Pinna*, horny-looking, ragged, mussel-shaped shells (Fig. 128), *Avicula* (fig. 129), etc.

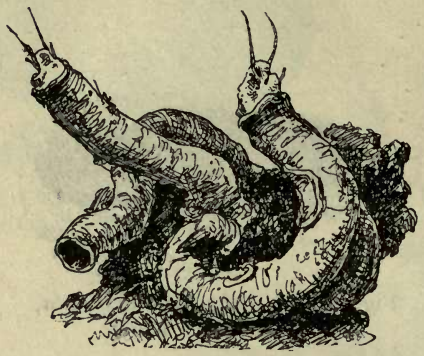
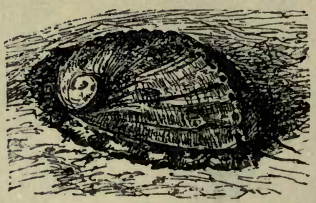


Fig. 125. *Vermetus gigas*, two living specimens and one empty shell, 1/2 nat. size. p 80.



Fg. 126. *Haliotis tuberculata*, 1/2 nat. size. p, 79.

Fig. 127. Two specimens of *Ostrea edulis* on a stone, 1/2 nat. size. p. 82.

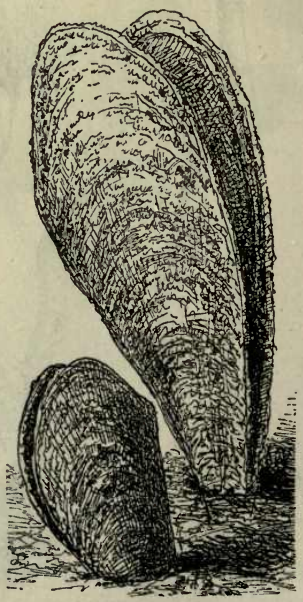


Fig. 128. Two specimens of *Pinna nobilis* partly buried in the sand, 1/4 nat. size. p. 83.

Fig. 129. Four specimens of *Avicula hirundo* attached to a stone, 1/2 nat. size. p. 83.

Fishes. Sea-horse (*Hippocampus*, fig. 130), head like the knight in chess, tail curling forward, generally attached to a coral or weed.

Crustaceans. Sometimes hanging down from floating wood or pumice the *Goose-barnacle (*Lepas*, fig. 131). Crawling on the sand or half hidden in it **Penaeus* (fig. 132) and **Stenopus* (Fig. 133).

Fig. 130. *Hippocampus guttulatus*, 1/2 nat. size. p. 95.

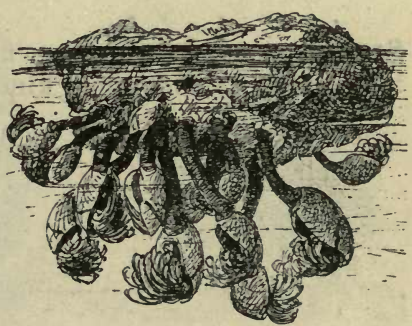


Fig. 131. *Lepas anatifera* hanging to a floating piece of pumice-stone, 1/2 nat. size. p. 75.

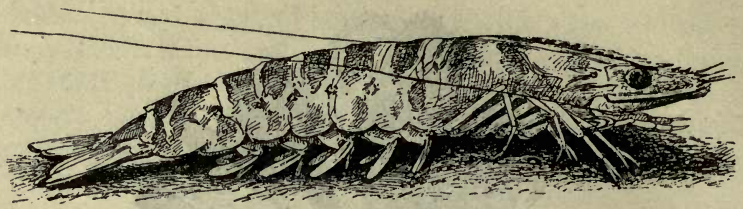


Fig. 132. *Penaeus caramote*,
1/2 nat. size. p. 70.

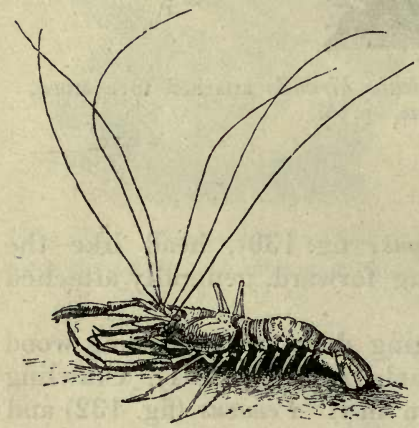


Fig. 133. *Stenopus spinosus*,
1/2 nat. size. p. 70.

Fig. 134. *Cerianthus membranaceus*,
1/2 nat. size. p. 57.

Sea-anemones. *Cerianthus* (fig. 134), beautiful grass-green, or brown, and other kinds. Plants as in tank Nr. 21.

Ask the attendant to drive the tube-worms back into their tubes.

Tank Nr. 23.

Smaller **Crustaceans** (p. 70), especially Hermit-crabs (fig. 135 and fig. 136), bearing stolen shells with sea-anemones, or sometimes sponges, adhering to them. The common Green Crab (*Carcinus*, fig. 137). Noticeable is the Bashful-crab (*Calappa*, fig. 138), half globular, with reddish spots, scarcely looking like a crab. Other crabs are *Dromia* (fig. 140), carrying about large orange-coloured or white sponges (*Suberites*); *Dorippe* (fig. 142), very flat; *Ilia* (fig. 141), round, small; *Lupa* (fig. 139), much like the Green Crab; *Eriphia* (fig. 144), large and powerful; *Inachus* (fig. 145), with long, slender legs; *Pisa* (fig. 146). *Lambrus* (fig. 143), with long sideways claws; Prawn (*Palaemon*, fig. 147). The Mantis-prawn (*Squilla*, fig. 148) is of a lobster-form, half transparent with black eye-like spots on its tail.

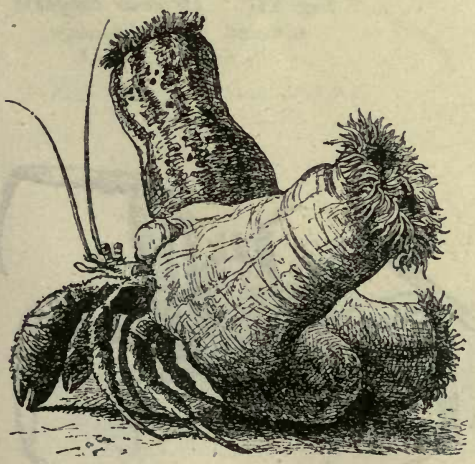


Fig. 135. *Pagurus striatus* in a whelk-shell and bearing three Anemones, 1/2 nat. size. p. 71.

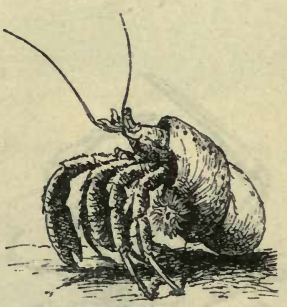


Fig. 136. *Eupagurus Prideauxii* in a shell and bearing the Anemone *Adamsia palliata*, 1/2 nat. size. p. 71.

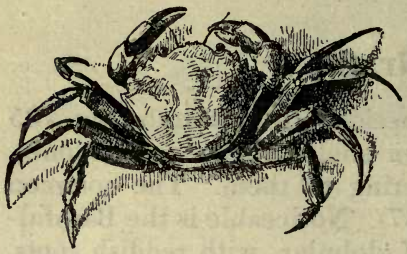


Fig. 137. *Carcinus maenas*, 1/2 nat. size. p. 74.

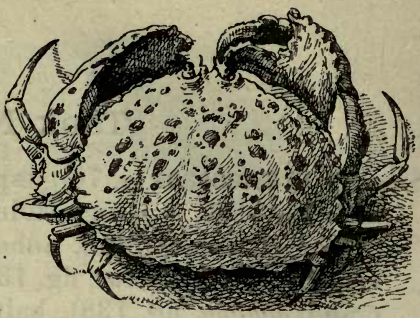


Fig. 138. *Calappa granulata*, 1/2 nat. size. p. 73.

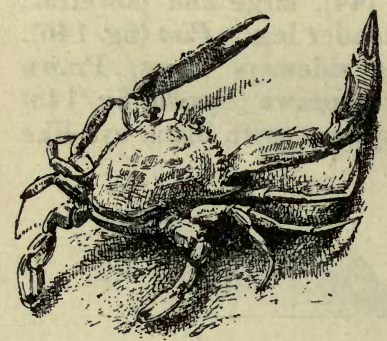


Fig. 139. *Lupa hastata*, 1/2 nat. size. p. 74.

Fig. 140. *Dromia vulgaris* covered with a sponge, 1/2 nat. size. p. 73.

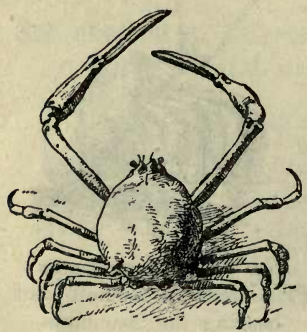


Fig. 141. *Ilia nucleus*, 1/2 nat. size. p. 73.

Fig. 142. *Dorippe lanata*, 1/2 nat. size. p. 73.

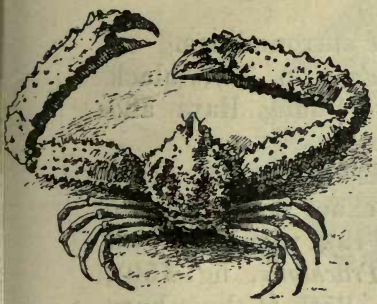


Fig. 143. *Lambrus angulifrons*, 1/2 nat. size. p. 73.

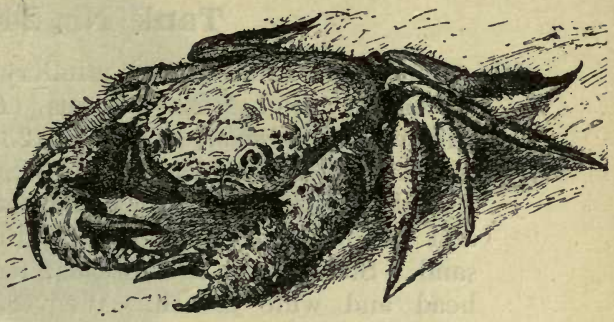


Fig. 144. *Eriphia spinifrons*, 1/2 nat. size. p. 74.

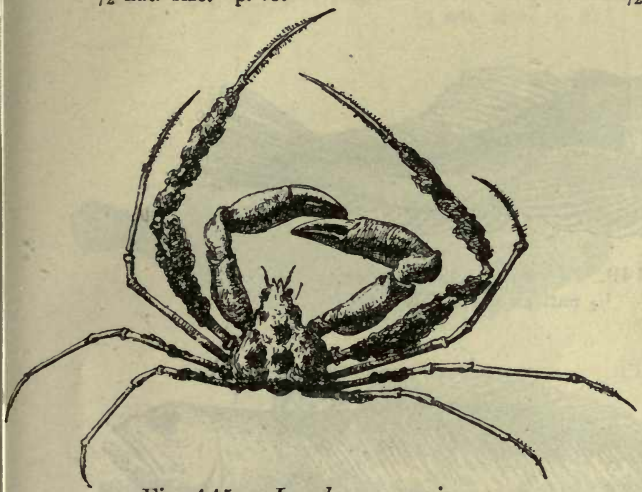


Fig. 145. *Inachus scorpio*, 1/2 nat. size. p. 73.

Fig 146. *Pisa tetraodon*, 1/2 nat. size. p. 73.

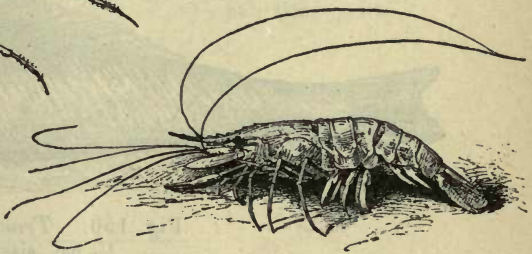


Fig. 147. *Palaemon xiphias*, 1/2 nat. size. p. 70.

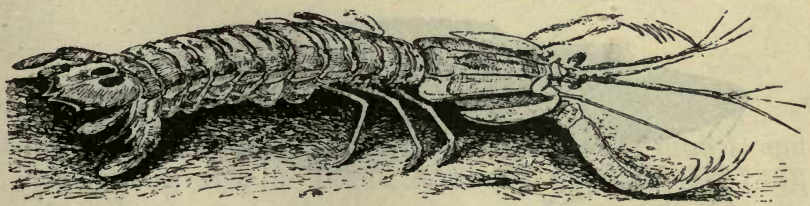


Fig. 148. *Squilla mantis*, 1/2 nat. size. p. 74.

Tank Nr. 24

illustrating concealment and mimicry of surroundings.

On the sand Musk-octopus (*Eledone*, p. 77), black and white. *Squilla*, see tank 23. *Young Rays and Angler-fish, see tanks 10 and 12.

Hidden in the sand, **Fishes:** Soles (*Solea*, fig. 153) and Turbot (*Rhombus*, fig. 152), the exact colour of the sand. Star-gazer (*Uranoscopus*, fig. 149), with big oval head and wide mouth. Weever (*Trachinus*, fig. 150), long-shaped body, head like a frog. Both of these bury themselves all but their eyes. Rockling (*Motella*, fig. 151).

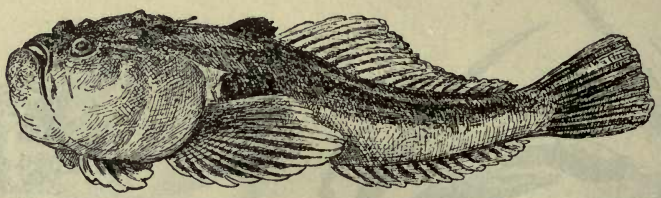


Fig. 149. *Uranoscopus scaber*,
1/2 nat. size. p. 91.

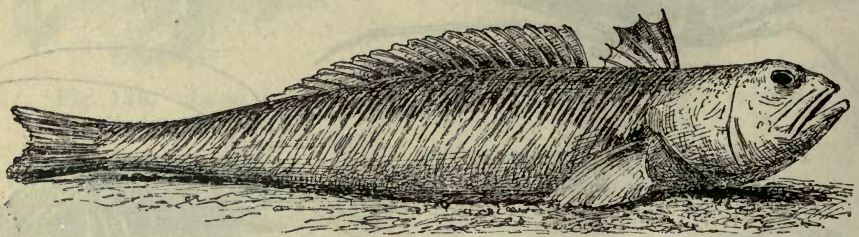


Fig. 150. *Trachinus draco*.
1/2 nat. size. p. 91.

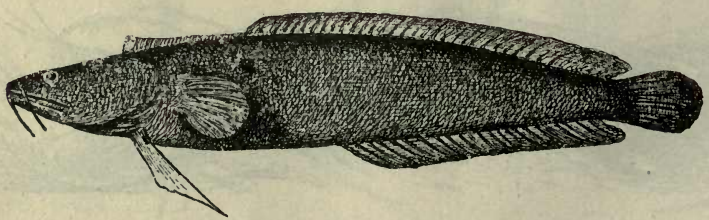


Fig. 151. *Motella vulgaris*,
1/2 nat. size. p. 93.

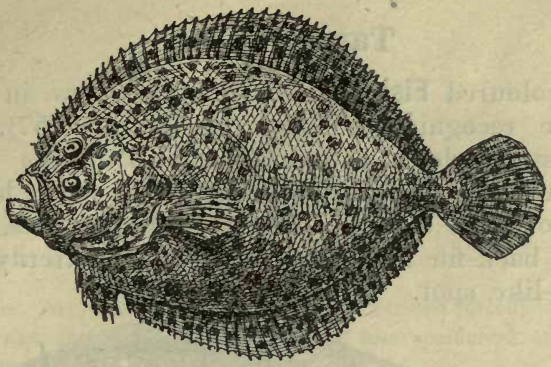


Fig. 152. *Rhombus maximus*,
1/4 nat. size. p. 92.

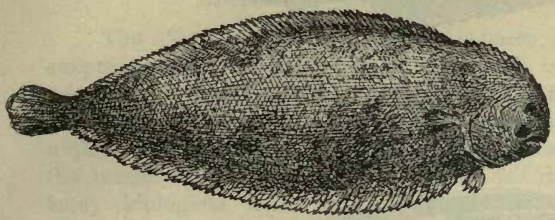


Fig. 153. *Solea vulgaris*,
1/3 nat. size. p. 92.

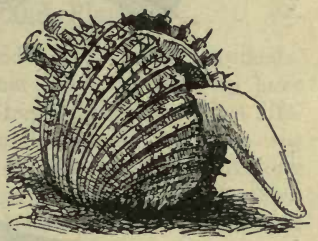


Fig. 154. *Cardium aculeatum*,
1/2 nat. size. p. 84.

Bivalves. Cockle (*Cardium*, fig. 154); *Pectunculus*, much larger, shell without spines.

Tank Nr. 25

showing other cases of imitation.

Fishes. *Scorpaena* (fig. 43), ragged, mottled brown and red. These with the **Crabs**, *Maja* (fig. 49), *Pisa* (fig. 146), etc., closely resemble the stones among which they lie.

Tank Nr. 26.

Brightly coloured **Fishes.** Lettered-perch, as in tank 14, may be recognized. *Coris vulgaris* (fig. 157), a shiny white stripe down the side, and *Julis pavo* (fig. 155), with peacock-blue fins. *Xyrichthys* (fig. 156), larger than those, of pink colour. Butterfly-fish (*Blennius*, fig. 158), with a back-fin like the wing of a butterfly, bearing an eye-like spot.

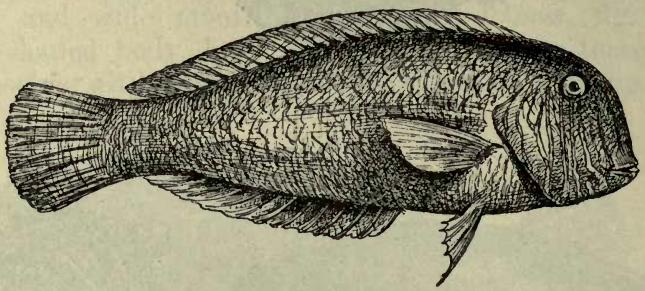


Fig. 156. *Xyrichthys novacula*,
1/2 nat. size. p. 96.

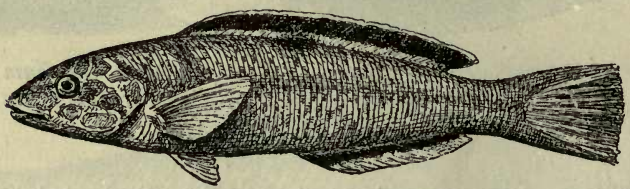


Fig. 155. *Julis pavo*,
1/2 nat. size. p. 96.

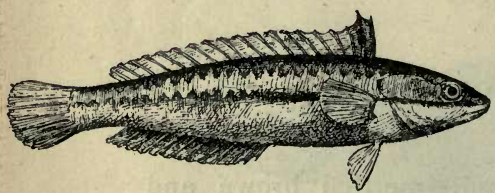


Fig 157. *Coris vulgaris*,
1/2 nat. size. p. 96.

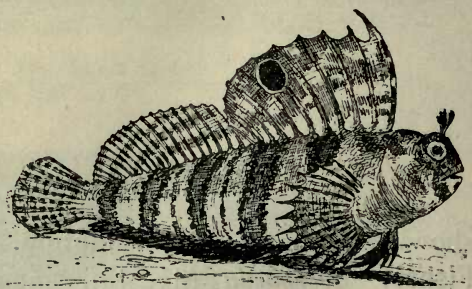


Fig. 158. *Blennius ocellaris*,
1/2 nat. size. p. 93.

PART SECOND.

In this part the animal world is described briefly in its natural order and not according to the more or less accidental arrangement of the tanks in the aquarium.

Since there are many animals in the aquarium, which in their appearance and habits so closely resemble plants as easily to be mistaken for such, it may not be out of place to devote a few words to the explanation of the

Differences Between Animals and Plants.

The Plants, adapted to live on gases and salts, and the Animals, adapted to live on vegetables and on each other, are supposed to have arisen as two well-defined groups out of the lowly forms of earliest life. The earliest living things cannot have been exactly animal, for there was nothing to eat; but they need not have been exactly vegetable. Among the microscopic organisms even now existing there are several which many biologists hold to be not properly classed as either animal or vegetable; an instance of such are the much talked-of Bacteria.

But of the beings of larger size, such as those treated of in this guide, there are none whose nature is doubtful. It is a common mistake to suppose that Corals, Anemones, tube-inhabiting Worms, Sponges and Sea-squirts are half-way between plants and animals. They are all quite unequivocal animals. They are rooted like the plants, but whereas a plant supports an easy and indolent existence on the air, water and sunlight which compass it, with the mineral salts that soak into it, a rooted animal is not necessarily any less active than a free-swimming one. Not only the Corals, Tube-worms, and Sea-squirts, but bivalve Mollusks such as the oyster, fixed Crustaceans such as the barnacle, the sedentary though not fixed lancelet (a low Vertebrate, see p. 87), with many others, obtain their food like the Sponges by actively causing currents to pass through them, or over their surface, and filtering from the water the nutritious particles it contains. The current is generally caused by minute vibrating hairs. It will be seen that for the purpose of obtaining food, it is just as efficient and quite as much exertion if, instead of the animal passing through the water, the water passes through the animal.

A fixed career requires little intelligence, and we consequently find all the different animals which have so settled their lives characterised by the possession of much less brain, or its equivalent, than their roving relations. But they have well-developed muscles and digestive organs,

and with all their innocent and flower-like beauty, lead not only active but predatory lives. For the most part it may be affirmed with certainty that they are the descendants of freely swimming animals which have preferred security to independence and monotony to danger.

Roughly speaking, the differences between plants and animals are as follows. Few, if any, plants are known to digest solid food; almost all animals do so. Few, if any, animals have the peculiar green colour which enables a plant in the sunlight to feed on air; most plants possess it. — The great majority of plants derive their strength from a supporting honeycomb of *cellulose* (the substance of which cotton is composed) or allied woody matters containing no nitrogen; these have been met with in the animal kingdom only among the Tunicates (see p. 84). Most animals possess supporting structures of the nature either of horn or gristle, containing much nitrogen; these substances have not been found in plants. — Plants rarely show any strong power of movement, animals are rarely without it. — Last, but not least, an animal shows signs of relationship to other animals, and a plant to other plants. With the exception of the occurrence of a kind of cellulose in those most undoubted animals, the Sea-squirts, there is not one of these characters in which any of the creatures above referred to approach the plants.

It is worth adding a word to say that the old conception of the "Vegetable" as a half-way house between "Animal" and "Mineral" is very delusive. The structure of the final living matter in plants and animals appears almost identical, and all the differences which can be enumerated between them sink to nothing beside the gulf that separates both from non-living matter.

SPONGES (PORIFERA).

Although in the earlier part of the last century it was debated whether sponges were plants or animals, close investigation soon rendered their animal nature undoubted. It was early remarked that "sponge" when burnt gave off a smell of burning hair or horn, and exact analysis showed it to be nearly allied to these substances. This in itself gave reason to suppose that the chemistry of their life was animal rather than vegetable. Though a living sponge is fixed and apparently motionless, it was found that the holes in its surface are capable of opening and shutting, and that from the larger of them, when open, there is usually a strong stream of water issuing. This is compensated for by small entering streams through other holes far more numerous but generally invisible without magnification. Further it was found that the young sponge (varying from microscopic size to that of a pin's head) swims freely about by means of little waving hairs (flagella) over its surface. Finally it was shown that sponges live on solid food. While thus possessing all those characters that are more frequent among animals than plants (see p. 53) they never contain any traces of the cottony and woody substances especially characteristic of the vegetable kingdom.

The water entering by the small pores passes through a system of branching and fine canals, and is collected again by a similar system

into the outflowing current from the large holes (oscula). At the junction between the two systems of tubes are the most vital organs of the sponge, little swollen cavities of microscopic size walled in with tiny living particles each bearing a vibrating hair, which it lashes on the current, and a transparent filmy skirt, with which it catches any food that may pass.

All this labyrinth of canals and cavities is living, soft flesh. To prevent it falling a ready prey to the first hungry animal that passes, it is set through and through with little flinty needles or thorns. A smaller group of sponges has its spines of chalk, to serve the same end. A very large number of the flinty sponges cement their spines together with the horny substance already referred to; a few have lost the flinty spicules entirely, and, to withstand better the shocks of the waves, have replaced them by the more elastic cement. The net-like skeletons of this last small group form the *sponges* — bath-sponges, toilet-sponges, and the rest, with which we habitually associate the name. The animals in which they were contained are killed by exposure to the air, and then removed by repeated washing.

The chalky sponges (*Calcarea*) are mostly small, and either grey or white; a fair type is the **Sycon raphanus** of which a variety peculiar to the Aquarium grows thickly on the walls of the tanks (Fig. 159). The flinty sponges (*Silicea*) are the most numerous and varied; to these belong in the Aquarium the orange-coloured branches of **Axinella** (Fig. 120), the yellow balls of **Tethya** (Fig. 119); also the apparently free-moving **Suberites** (tank 23, see p. 73) under which, however, will be found in such case a crab using it as a protective covering.

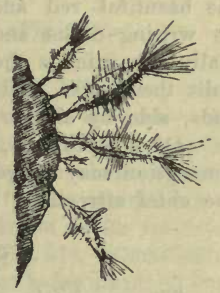


Fig. 159. Some specimens of *Sycon raphanus*, attached to a piece of rock at the left hand.

The **sponge of commerce** is of the form we know in its domestic relations, but in life shows on its surface the largest only of its numerous holes (Fig. 118); over all the rest the dark, slate-coloured flesh forms a continuous film. It is obtained by diving, dredging, or harpooning with a long trident; the principal markets are at Trieste and Paris. Of the different kinds the finest and most costly is the Levantine sponge (*Euspongia officinalis*) which, in its varieties, extends on all the eastern Adriatic and Mediterranean shores. It is not found west of Naples, and on the Italian coast no sponges occur in remunerative quantity, though quite recently some beds have been discovered near Sicily. The harder Zimocca sponge (*Euspongia zimocca*), from Asia Minor and Egypt, fetches about one tenth of the price, as does the large coarse horse sponge (*Hippospongia equina*), found in all the Levant and extending along Africa to the Straits of Gibraltar; it is honey-combed with wide holes. Of the last genus (*Hippospongia*) are the American "glove sponge" and "sheeps-wool sponge"; their "hard-head" is related to the European Zimocca, while their velvet sponge and grass sponge are independent species. The Bahamas

and Caribbean sea form the American sponge-field. — After the removal of the soft parts of the sponge the fishermen usually fill the skeleton with sand, so as to increase its weight and thus to obtain a higher price for their goods. For this reason it is necessary to rinse newly bought sponges repeatedly so as to remove all foreign matter, and it is well at first to add a little hydrochloric acid to the water. The sponge of commerce is found rarely in the Bay of Naples. It chiefly frequents rocky coasts and coral reefs; it does not live in very deep waters, where its elastic skeleton is of no use, nor in cold ones, where we must suppose that the material composing it cannot be formed. — Mutilation injures a sponge but slightly; divided with a sharp razor even the smallest fragments retain their life. After a time they may die, and without doubt they suffer from the absence of the remainder of the cooperative body; under favourable conditions, however, they will live and grow. Ignorant opposition of the fishermen has prevented this property from being practically used.

POLYPES (ANTHOZOA).

If it be difficult to the lay mind to apply the term Sponge to organisms, which in a living condition are not at all of a spongy nature; it will be found equally difficult to picture as Corals anything else than the beautiful red and white branches which are displayed as ornaments on writing-desks and chimney-pieces. And yet these branches are not really the animals themselves, but only the framework which they have built themselves, and in which they live imbedded in hundreds or thousands, side by side or one above the other.

Of the *polypes*, the animals which build up the corals, the best conception may be gained by examining those forms which are considered the chief attractions of the northern Aquaria, namely the

SEA-ANEMONES (ACTINIÆ).

These animals exhibit a cylindrical body, attached by an adhesive disk to some fixed object and bearing at its free end numerous very mobile tentacles. These encircle an aperture, which serves both as mouth and as anus (Fig. 160); it leads into a capacious stomach in which the food is digested. The soft and apparently unprotected polype is really very well armed. Many parts of the body, but especially the tentacles which serve to catch its prey, are provided with numerous microscopic vesicles, the so-called *stinging-cells*, which each contain an acid liquid and a spirally coiled thread. When the animal comes in contact with its enemies or its prey thousands of these stinging-cells burst, ejecting forcibly the long filament; this bears a sharp point and is often barbed, while the noxious liquid in its core renders the tiny wound it makes sufficiently poisonous to benumb or even kill. The ejection may be compared to blowing out the fingers of a glove when the yare tucked in. — The Anemones are extremely voracious: they are not content with feeding on the pieces of meat given them, but also catch living worms, crabs, snails and fishes which are often much larger than themselves.

They move from one place to another very rarely, and then very slowly. If they are disturbed, they contract themselves into such small masses, forcing out the sea-water they have taken up, that they are almost unrecognisable. Their tenacity of life is extraordinary and enables them to be easily kept in aquaria; in many cases one and the same individual has been kept alive for years. One is said to have lived for over 50 years in a small aquarium in Edinburgh and to have brought forth thousands of young ones during that time. — Some Anemones are eaten by the poorer classes of Naples.

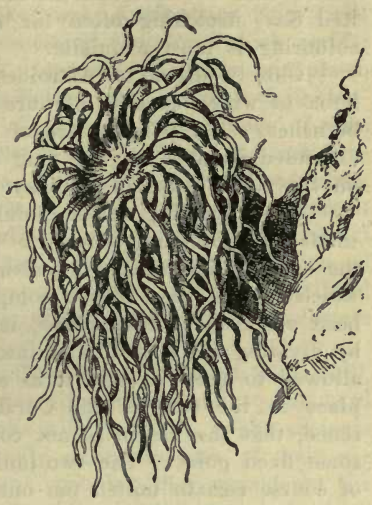


Fig. 160.

Of the numerous kinds of Anemones many are richly coloured; we would mention especially the common **Anemonia sulcata** (Fig. 160) which grows in hundreds on the rocks, like flowers in a bed. Finer even than this is one which has up to the present time only been found in the Bay of Naples, the **Alicia** (Fig. 111). It lives at great depths and, being of rare occurrence, is not always present in the Aquarium. When expanded, i. e. when the body and tentacles are swelled out with sea-water, this species is probably one of the finest. **Adamsia** (Fig. 136) is interesting an account of its habit of sharing the possession of some whelk- or other shell with a hermit-crab, by which it allows itself to be carried about (tank 23, see p. 72). On the slightest contact it draws in its tentacles. The orange-red **Cereactis** exhibits fine colouring (Fig. 51). **Cerianthus** (Fig. 134) differs from the other Sea-anemones in not being fixed; it lives in a loose covering which it makes deep in the sand, only a small portion of its body projecting (tank 22). It is one of the largest Sea-anemones and reaches a length of 8 inches; a specimen in the Aquarium has lived 11 years.

Proceeding from the Actiniae we can now more easily understand the structure of the **Corals**. If the Anemones had the power to deposit a calcareous covering on the outside of their body, or a similar skeleton within their body-wall, these hard parts would, after the death of the animal, be termed corals. The fine orange-coloured Coral, **Astroides** (Fig. 52), which lives on the rocks of tank No. 9, may be considered as an Anemone provided with such a calcareous framework. Spreading out their rings of tentacles the numerous animals side by side present the appearance of an orange-coloured carpet, but then the framework is not visible. Only after the orange-coloured animal has died and decayed away, the remaining white calcareous skeleton becomes visible in the form of a honeycomb; this can be seen in several parts of the tank. The coast of Italy is in many places covered with this coral; those who

have made by boat the beautiful trip from Amalfi to Scaricatoio will have had ample opportunity of seeing the orange belt it forms on the rocks immediately below the water-line. Similar corals form the large reefs which are met with in the southern seas (even as far north as the Red Sea) stretching often for miles, and several fathoms deep. Their colouring is most exquisite.

Closely allied to Astroides is **Dendrophyllia** (Fig. 109), the skeleton of which consists of pure white carbonate of lime and forms large branches. The polypes are of the colour of sulphur and exhibit in the expanded condition a fine ring of tentacles. This form is fairly common on the coral banks of the Bay of Naples.

The branching of the corals takes place by means of the two methods of reproduction termed "fission" and "budding" respectively. In the case of fission one organism splits into two or more parts, each of which will develop into a complete individual. This process has often been observed to take place; it has also been successfully brought about by dividing a living animal into suitable pieces, which have then been allowed to grow on and form complete polypes. A similar fission takes place in the case of the Coral-polypes, but with this important difference, that the fission is not complete, but both pieces remain attached at some fixed point. The two individuals form calcareous coverings, which of course remain united the one to the other. Repeating this fission there can arise a colony of corals, and in the course of centuries those immense coral-reefs of which mention has been made above. The second and even more rapid process of reproduction is that of budding. In this case the parental polype remains intact, but at one point or other of its body a new growth begins, from which, as from a bud, a new individual is formed; this in the case of the Corals does not separate from the first individual, but remains attached to it. The whole colony is either supported internally or surrounded externally by the calcareous framework or covering, which the individuals form themselves; when they are dead, this retains the appearance of trees or bushes, or assumes other curious shapes. But whatever may be their form or colour, it must always be remembered that these "corals" are not the coral-animals themselves; they are only the hard, skeletal parts, which have been formed by millions of small polypes. Of these many hundreds of generations have already died, while their offspring, the present generation, stretch out their delicate tentacles like tiny feathery crowns from the pores of the coral-trees.

Of these tree-like corals we would mention first the Sea-finger ("deadmen's-fingers"), **Alcyonium** (Fig. 108), the skeleton of which does not form a united framework, but consists of numerous loose calcareous spicules; so that the animals are able to swell themselves out by taking up a large amount of sea-water.

The Sea-pen, **Pennatula** (Fig. 110), can also swell itself out at pleasure by taking in sea-water. When not thus expanded the body is flabby, and the animal to all appearance dead; but when it has taken up sea-water it becomes beautifully transparent and erect, and the leaf-like lappets are studded along their upper edge with delicate polypes

like transparent flowers. The Sea-pen can move about freely and burrow deep into the sand with its stalk. At night it phosphoresces, when roughly handled, with a greenish light.

The family of *Corticate Corals* are well represented in the Aquarium. To begin with we have the Black Coral, **Antipathes** (Fig. 107), and the Sea-fan, **Gorgonia** (Fig. 105), possessing skeletons which consist of a horny substance. The branches of Gorgonia all lie in one plane, and when the polypes protrude their bodies and expand their tentacles, they project like small feathery flowers on either side of each branch. In the Bay of Naples there exist white, yellow, and red Sea-fans, the latter being the most numerous. Antipathes has a glossy black skeleton which attains in large specimens the thickness of a finger; it is used, although rarely, as the so-called black coral for ornamental purposes. The skeleton of the White Coral, **Isis** (Fig. 104), consists of alternating pieces of horny and calcareous matter; in the Red Coral which belongs to the same family, the skeleton is entirely carbonate of lime (chalk).

The great value of the Red Coral, **Corallium rubrum** (Fig. 106), for ornamental purposes is due to its beautiful colour and to the hard texture of its skeleton, enabling it to take a high polish. The ancients valued corals greatly, but they had a wholly erroneous idea of their nature, an idea shared even now by many people; they considered the Coral to be a plant, which remained soft while in the sea, but which became hard suddenly on being taken out of the water. But if a branch be examined, as soon as it has been freshly fished, it will be found to be enveloped by a coating, also of red colour, just as the wood of a tree is enveloped by its bark. Such a branch placed carefully in a large vessel of fresh sea-water will after a short time shew at numerous points of its surface the expanded coral-animals each with its eight feathery tentacles. Each individual has the structure of a polype, as described above, and is organically connected with all the others by means of canals, which transmit food from one living polype to the other. In the covering, besides these canals, are numerous microscopic spindle-shaped particles of carbonate of lime; the axis is formed by a fusion of such particles. This structure of the coral is very readily distinguished under the microscope, by the aid of which instrument all imitations can be easily detected. — Corals reproduce by means of eggs or by buds. There exist separate male and female colonies, besides those which bear both sexes; sometimes, too, hermaphrodite polypes (individuals with male and female reproductive organs) are found. The egg develops within the maternal polype into a pear-shaped being, which makes its way out through the mouth of the mother-polype and swims about freely for some time; after this it fixes itself with one end and becomes transformed into a polype, which forms new individuals by budding and thus gives rise to a new colony.

The Red Coral is a gift of the Mediterranean. Here it grows on rocky banks near the coast at a depth of from 40 to 100 fathoms, rarety deeper, and is especially obtained on the Ionian Islands and on lhe coasts of Algiers and Tunis; the last named place alone yielding

about 60,000 pounds a year valued at two million francs. There is also a coral bed between Naples and Capri, and from this one the specimens in the Aquarium are obtained. The apparatus for coral-fishing consists of a cross made of heavy wooden beams, to which are attached pieces of old nets, untwisted rope ends and other such material; the whole is dragged by means of a strong rope over the bottom of the sea. The branching corals are entangled in the nets and ropes, break off and are pulled up with them. To use the corals the "bark" with the polypes is brushed off and the outermost layer of the skeleton filed away; afterwards it is ground with emery-powder and oil, and finally polished with steel. The beads are turned and pierced on a lathe, the figures are cut out with graving-tools. The value of corals varies already greatly even before they are worked. The thicker roots are often perforated by boring animals (worms and sponges) and fetch between 5 and 20 frs. per kilogramme. Good ordinary pieces are sold at 40—70 frs. and choice, salmon-coloured pieces 400—500 frs. and even more; i. e. 200 to 250 frs. a pound.

In the Aquarium the Red Coral, inhabiting usually deeper waters, does not last long and is therefore generally not seen in a living condition. A specimen will be found enclosed in a small glass at the bottom of tank 21.

MEDUSÆ or JELLY-FISH.

Those who come from northern seas, and remember to have found on the sands ugly and offensive masses of jelly, will find it difficult to associate these with the large **Rhizostoma** (Fig. 79) and **Cotylorhiza** (Fig. 80), or with the smaller **Pelagia** (Fig. 81), **Tima** (Fig. 82), **Olindias** (Fig. 84), **Carmarina** (Fig. 83) etc.; the living Medusæ have a very different appearance indeed. Their almost complete transparency, the beauty of their movements, and often their brilliant colouring make them very attractive objects. As they swim, they take the form of a mushroom or an open umbrella, the regular opening and closing of the umbrella driving them upwards. Round its edge are situated the sense-organs, probably of seeing and hearing.

From the centre of the under surface of the umbrella hangs a long, generally hollow, gelatinous stalk, also transparent; it is provided at the end with an aperture, the mouth. In some jelly-fish, however, the stalk is short and divided into a number of small lappets, each of which bears a mouth leading into a common cavity, the stomach. From the edge of the umbrella hang down long tentacles, which the animal can at will contract and elongate to a considerable extent. These tentacles are provided with numerous stinging-cells, such as have been described in the case of the Actiniæ (see p. 56); and, as there, they afford an efficient means of defence for the delicate body. The unpleasant stings experienced occasionally in sea-bathing are generally due to contact with these jelly-fish. Some species, indeed, which attain a size of one to two feet and a weight of 50 to 60 pounds, produce very dangerous stings.

A few species shine at night with a greenish light; thus Pelagia has received the specific name of noctiluca ("night-lantern"; not to be

confounded with the much humbler organism, which has *Noctiluca* for its first name). — Some species of fish spend the early part of their life under the protection of the umbrella of Rhizostoma and Cotylorhiza, and even eat away parts of the medusæ.

The migrations of the Medusæ are of especial interest. At certain periods enormous quantities are met with in active or passive migration. The shoals of Medusæ thus found are so large that ships are often impeded in their course for days together, the animals swimming in so dense a mass that a stick, plunged into their midst, remains upright as if driven into something viscid, and ordinary rowing boats can scarcely force their way through. These migrations are yet to be explained. The lesser swarms which are sometimes met with on the coasts and in bays are in all probability due to the curious mode of reproduction of these animals known as alternation of generations.

This Alternation of Generations — first discovered, in the case of the Salpæ (see p. 86), by the poet Adalbert von Chamisso, on the Kotzebue expedition round the world — was first formulated as an important biological law by the zoologist Steenstrup. It may be summed up as follows. An individual *A* produces individuals which are not like itself, but of very different nature and which we may call *B*. *B* also gives rise to individuals unlike itself, but like *A*. In other words: For *A* to reproduce *A* forms, an intervening form *B* is necessary. In the case of many Medusæ – not of all — this intervening form appears as the so-called

Hydroid-polypes,

which have entirely the appearance of plants and are very similar to branches of corals. The Aquarium contains sometimes the very delicate **Tubularia, Pennaria, Aglaophenia,** and **Antennularia** (Fig. 112—115). Generally they arise from eggs produced by Medusæ, branch by fission and budding and form thus, just as the corals do, larger or smaller colonies. At fixed periods they produce buds which separate from the colony and swim about as Medusæ. These again lay eggs, which give rise to new Polypes. But this is not the case in all species. In some the Medusæ always remain attached to the colony, and in these cases they are usually so reduced in size and organization, that they are scarcely to be recognized as Medusæ at all.

The Hydroid-polypes are found in enormous masses on stones, reefs, and rocky coasts among the sea-weeds. The animals, which form these colonies, live on the smallest crustacea, worms, infusoria, etc., which come within reach of their tentacles and are stunned by the action of the stinging cells.

SIPHONOPHORA.

These, among the most wonderful of the inhabitants of the sea, are at once the delight and the despair of the naturalist. For the wonderful form and beauty of their body is associated with such delicacy, that it breaks to pieces at the slightest touch. The fact that, nevertheless,

especially in calm weather, specimens of **Physophora** (Fig. 89), **Forskalia** (Fig. 92), **Hippopodius** (Fig. 90) and others may be seen in the Aquarium, is due to the particular method employed in their capture (see foot-note).

The Siphonophora are looked upon by most naturalists as free-swimming colonies. It is not rare to find individuals of one species thus united; the corals form one of the most striking examples. The case of the Siphonophora, however, is somewhat different; here the individuals are not all similar and performing similar functions, so that each can live independently of the other; but the colonies are made up of very differently shaped (polymorph) individuals, each form undertaking one of the different functions, which have to be performed. Special nutritive polypes undertake the nutrition of the colony; special bell-shaped individuals, like medusæ, perform the swimming movements; true medusæ are charged with the reproduction. In short, we have a "division of labour" taking place as it does among the ants and bees; but with the difference, that among them the polymorph individuals (workers, drones, queen) are separate one from the other, whereas in the Siphonophora they are inseparably united. — While Physophora (Fig. 89) gives the impression of medusæ bound together by a slender thread or stalk, in the beautiful blue Sallee Man, **Velella** (Fig. 91), this common stalk is replaced by a wide horny disk overshadowing all the polypes and bearing on its upper surface a triangular crest, which catches the wind like a sail and enables the colony to drift along on the surface of the water. Physophora appears clearly to be a group of animals, Velella only one, but there are all transitions in the degree of union.

CTENOPHORA.

The Ctenophora agree with the Siphonophora and Medusæ in the transparency of their body, a character which is of frequent occurrence in marine animals. There are some transparent Mollusks, there are transparent Annelids, transparent Crustacea and even transparent Fishes. The reason for this occurrence of transparent forms must be sought for in the advantage which they gain by such a character. Probably the advantage consists in the difficulty which their enemies have in seeing them, and in the facility with which they can surprise and capture their prey. These transparent forms*), even the delicate Ctenophora and

*) These transparent forms live chiefly in the open sea and are therefore often grouped together under the name of *Pelagic Animals*. In a calm sea, and if the light be not too intense, they are found at the surface of the water; other conditions cause them to sink to some depth. They can thus not be caught regularly, and in stormy weather they may be missing in the Aquarium for some time. Usually the currents at sea bring them together in large numbers, and it is only necessary to steer into these "Correnti" to catch them in swarms. The large forms are carefully scooped up with buckets, and transferred to the Aquarium; the smaller ones and the microscopic ones are caught with a net made of the finest silk gauze, in the meshes of which they become entangled, and often of course damaged. — Most Ctenophora and Siphonophora, in spite of their size, are so delicate that they collapse immediately they are handled the least roughly, and

Siphonophora, are nearly all voracious robbers; often swallowing animals, which one would suppose might easily overcome them. Inside the cavity of Beroë or in the pendant stalk of a Medusa are often seen small fish which the apparently delicate organism dissolves and digests.

The Neapolitan forms include the barrel-shaped, comparatively tough **Beroë** (Fig. 86); the much more delicate form **Callianira** (Fig. 87); **Eucharis** (Fig. 85) consisting chiefly of water; and lastly the curious Venus's Girdle, **Cestus Veneris** (Fig. 88). All of these attract the attention of the observer by the beads of light which seem to run over the body in various directions, displaying all the colours of the rainbow. This curious play of colours is caused by innumerable little plates, which are placed in vertical rows one above the other, and are moved up and down with great rapidity. By them the rays of light are reflected in such a way that the colours of the rainbow, which make up white light, appear separately. These plates, arranged in rows like the teeth of a comb, have caused these organisms to be called Ctenophora ("comb-bearers").

ECHINODERMS.

This group of animals comprises the Sea-urchins, Sea-stars, Sea-cucumbers, and Feather-stars. They are especially interesting to those not acquainted with marine life, for no member of the group occurs either in fresh water or on land. But the Echinoderms differ from most terrestrial and freshwater animals in a further way. If the lay mind be rather doubtful as to details of anatomical structure, it knows that, for example, birds, fishes and insects possess a head; that they are provided with wings, fins or legs. They have a mouth, and eyes, and many other organs with which the least zoological of men is familiar from every day observation: but how should he recognize these in a sea-urchin or in a starfish? These animals live, therefore they must eat; but where is their mouth? where are the limbs with which they grasp their prey? They live in the sea, but how do they move about? Do they crawl? Can they see and hear?

First of all it must be remembered that Corals and Medusæ, for instance, can do very well without head and tail, arms and legs, fins or wings, and so can the Echinoderms. Still, the latter have a much more complex structure than the former. Even their outward form is most variable. Some are almost spherical (Fig. 7), others are flat like a leaf (*Palmipes*, p. 5), others again star-shaped (Fig. 1 and 3); some are cylindrical, something like a cucumber in shape (Fig. 10); and lastly some have the form of a flower attached by a short stalk, and seem to possess sepals and petals (Fig. 5). The skin of these animals contains a large number of different but regularly arranged calcareous plates. In

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can therefore not be taken out of the water. They only live a few days in the Aquarium, although they are placed separately in large glass cylinders and seem to flourish very well at the commencement. — Most pelagic forms shine at night, some with a very strong light, and contribute largely to the **Phosphorescence** so frequently observed at sea.

the sea-urchins these plates are fixed together so closely, that the spherical body seems to consist of a solid inextensible substance; in the starfishes the plates are more loosely connected one to the other, and allow the body a certain amount of flexibility so that the arms (the term applied to the rays of the starfish) can be bent upwards and downwards and from side to side. (These movements are best seen, when a starfish is lying on its back and tries to turn over onto its under surface. At the request of the visitors the attendant will turn a starfish on its back.) The Brittle-stars are able to perform snake-like movements with their long thin arms, and some with branching arms swing them about like whips, and so progress. The skin of the Sea-cucumbers only is entirely leathery, and contains instead of the calcareous plates innumerable extremely small pieces of carbonate of lime, often of very curious shapes such as anchors and rosettes; they are consequently able to straighten their body and bend it again in any direction.

In the Sea-urchins and Starfishes one can scarcely observe these calcareous plates on account of the large number of spines and other processes with which in life they are covered. But on dead specimens — the attendant has always some at hand — one can easily see the immense number of these plates; in large examples a hundred thousand may be present! — How can Sea-urchins and Starfishes move about in the water? In answer to this question we must ask the reader to observe carefully some specimen, which is attached to the glass front of the tank. He will then notice on the side towards the glass numbers of fine threads which bear at their extremities each a small sucker. These threads are very mobile, stretch themselves and contract again like so many worms, and are easily fixed to the glass. These "sucker-feet" are hollow, and the animal forcing water into them causes them to elongate considerably; when they have fixed themselves by their sucker they contract again and draw the animal toward the point of attachment. The water necessary for the expansion of the feet is taken into the body by a special system of canals (which have nothing to do with the blood system) leading to every one of the feet. These feet are equally important to the Sea-urchin to catch its prey. If any animal upon which they can feed comes into their vicinity, they protrude some of these feet till they reach its body. Should it not notice in time the attack which is being made upon it, it is lost; other sucker-feet follow rapidly, and soon the prey is wound round with hundreds of fine threads, and is slowly drawn to the mouth of the Sea-urchin. All struggle is in vain, for if one or two sucker-feet are torn away others take their place, and soon the prey gives up the fight and is devoured. But, so as not to be recognized too soon in thus stalking their prey, many Sea-urchins cover themselves on their upper surface with all sorts of stones, shells, and pieces of sea-weed, and are thus more often successful. — The mouth of the Sea-urchins and Starfishes is on the lower surface of the body, and is therefore only visible when they lie on their back, or are attached to the glass on the front of the tank. Many Sea-urchins have five strong teeth of very complex structure, others live always buried in the sand and swallow it, so as to digest whatever organic substances it

contains, and then throw it out again. The Starfishes have no teeth, but the walls of their alimentary canal secrete such strong juices that they can kill animals which they have caught with their sucker-feet and brought to their mouth. Their food consists chiefly of shellfish, but often they will capture fishes and crabs. They are one of the most formidable enemies of fishery, especially of oyster-culture.

Like some of the Sea-urchins, most Sea-cucumbers live by swallowing sand and mud and digesting the adhering organic particles. Some (e. g. **Cucumaria**, Fig. 161) manage matters very differently. They remain motionless on a stone or other prominent object, stretching out their large branching tentacles and carrying them one after the other into their mouth, sucking off the small animals which in the meantime have settled upon them. With a little patience this proceeding may be easily observed. — Some Sea-urchins (e. g. **Dorocidaris**, Fig. 8) have very long spines; in these cases, however, the sucker-feet can be extended to a great length, for they must always reach beyond the spines. In many cases we find between the spines special moveable stalks bearing small pincers, which can also seize small objects. — The Starfishes have their eyes at the extremities of their arms. They can, however, probably not see very distinctly, but only distinguish between light and darkness.

Fig. 161. *Cucumari Planci*, 1/2 nat. size.

The Echinoderms are divided into four large groups:

1. The Feather-stars (Crinoidea), 2. the Sea-stars (Asteroidea) 3. the Sea-urchins (Echinoidea), 4. the Sea-cucumbers (Holothurioidea).

Of the Feather-stars the Aquarium contains **Antedon rosacea** (Fig. 5) in straw-coloured, orange-coloured, blood-red, or spotted brown and white varieties. Generally they hold on to coral-branches, so as to appear like flowers, growing on submarine trees.

The Sea-stars are divided into the Starfishes or Asterids, and the Brittle-stars or Ophiurids. The Starfishes are represented in the Aquarium by the genera **Luidia** (Fig. 6), **Astropecten** (Fig. 1), **Asterias** (Fig. 3), **Echinaster** (Fig. 2), **Palmipes**, and others; the Brittle-stars by **Ophioderma** (Fig. 4) and others.

The Sea-urchins are very conspicuous; **Echinus acutus** especially on account of its considerable size. The large yellow ovaries (roe) of **Strongylocentrotus** and allied forms are eaten in the fish-market raw as we eat oysters. **Sphaerechinus** (Fig. 7) is of a beautiful violet or reddish-brown colour; and **Dorocidaris** (Fig. 8) is remarkable on account of the size and thickness of its spines, which are few in number.

The Sea-cucumbers are very common in the Bay of Naples, and the Aquarium contains about half a dozen kinds; among others the brown **Holothuria tubulosa** (Fig. 10), attaining the length of one foot; and

Stichopus (Fig. 11), which is not round but flattened. Both of these are very remarkable for containing frequently within their body a fish, **Fierasfer acus**, 8 to 10 inches long, which at times may be seen protruding its head from the anus of its host. It feeds on small crabs, but to catch these it is obliged to leave its shelter. Some kinds of Sea-cucumbers are considered a great delicacy by the Chinese; what they call "Trepang" is nothing but the body of *Holothuria edulis* and other kinds deprived of its intestines and dried in the sun or by the fire. Thousands of people, chiefly Malays and Chinese, are employed in the fishery and subsequent distribution; entire fleets put every year to the coral islands between New-Holland and New-Guinea, where the fishing is most profitable; but the result of their labour is only palatable to the European taste when strong relishes have been added. — **Cucumaria**, see above page 65.

ANNELIDS (RINGED WORMS.)

The name "worm" calls up in most minds a feeling of aversion, since it is generally associated with such unpleasant forms as slimy earthworms and bloodthirsty leeches, tapeworms and trichinosis. While the English word includes, besides these, Cleopatra's asp ("the pretty worm of Nilus") and St. George's dragon ("the laidly worm"), the group of which we are treating is more definite and less terrible. Indeed, in the sea we find the large group to which the common Earthworm belongs, the Annelids, competing in delicacy of form and beauty of colouring with the most lovely Sea-anemones and other brilliant inhabitants of the deep. This will impress itself on the reader as soon as he takes a look at the worm-tank (Nr. 22) of our Aquarium, which sembles more a garden of miniature palms than a collection of worms.

The feathery spiral crowns of **Spirographis** (Fig. 121) wave about at the end of their slender stalk, the brilliant red tassels of **Protula** (Fig. 122) protrude from white calcareous tubes of irregular form, while in another place a confused mass of such tubes is dotted over with hundreds of many-coloured brushes, **Hydroides** (Fig. 124), all as delicate as flowers, reminding one more of the children of goddess Flora, than of animal forms. And yet all these organisms are true worms, which have built these leathery or calcareous tubes for the protection of their soft bodies, ringed and repulsive as the body of an Earthworm; the feathery palm-like crowns are only the wreaths of gill branches round their wormy heads. Touch one of these tiny crowns ever so lightly, and instantly it disappears into the tube; the worm has withdrawn itself into its abode, where it waits until the supposed danger has passed. Then, slowly and carefully, a bunch of plumes, looking like a camels-hair brush, will be pushed out of the tube; they will unwind and spread out again in all their glory. Even a slight disturbance of the water will frighten some of these worms into their hiding-places: and in some of the smallest kinds this sensitiveness goes so far, that they feel even the momentary darkening of the tank caused by a cloud drifting across the face of the sun.

In the sea we may often see a natural garden of this kind; looked at through the clear water of a rocky coast it is an enchanting sight, and always yields a rich harvest to the naturalist, not only of these worms, but of many other animals which have taken up their abode amongst them. — The tube is merely a house formed by the worm, and does not adhere to its body. But not all Tube-worms secrete calcareous shells or leathery ones, like those mentioned above; some saturate the sand in which they burrow with a slimy secretion of their skin and form in this way delicate tubes of sand. Such are possessed by **Arenicola**, the lug-worm, so much used as bait in England; in the same manner **Terebella** forms a dwelling, and its orange-coloured tentacles may be seen protruding from the sand at the bottom of the tank, twisting about in all directions in search of food. Others cement together small stones, shells, and other similar objects (Shell-binders); while some encase themselves with mud, or form long horny tubes open at both ends and resembling the shaft of a feather: **Onuphis**. This latter group crawl about freely like the grub of the Caddisfly, while the "palm-trees" of tank 22 fix themselves to rocks, woodwork, or other large objects, or simply bury the lower end of their tube in the sand. Some kinds are a veritable plague in navigation, accumulating in such masses on the keels of ships that they retard their progress.

All these animals, when young, are entirely differently constituted. From the eggs issue free-swimming larvae of very curious form, which after a while fix themselves to stones or weeds, and then by a complete metamorphosis change into the worm-like animal and encase themselves with a tube.

Besides these tube-inhabiting Annelids, of which all the warmer seas possess a variety of beautifully coloured forms, there is a second group, no less rich and varied: the free-living Annelids.

The Bay of Naples has long been celebrated among zoologists as one of richest localities for these worms, and up to the present date already (including the tube-inhabiting worms) about 300 different species have been described. Still only a small portion are suitable for the purposes of an Aquarium, as most of them live secluded in the mud or in the cracks of the rocks. One of the finest is the Sea-mouse, **Aphrodita** (Fig. 123), the bristling coat of which reflects with a bright metallic lustre all the colours of the rainbow.

Its nearest relation is the very common **Hermione**, which in spite of its beautiful name is a disgusting animal, the hooked spines of which penetrate into the hand that touches them, and cause inflammation. **Alciopa** (fig. 162) is as transparent as the jelly-fish and other pelagic forms, and like them lives near the surface of the sea. It is rarely seen in the Aquarium (Tank Nr. 20), since the capture of such animals, as already mentioned, depends so much upon the weather (see p. 62, foot-note).

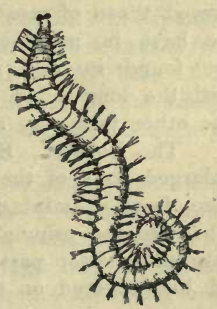

Fig. 162. *Alciopa Cantrainii*, 1/2 nat. size.

The Annelids have lately become a special field of study among zoologists, since their comparative anatomy has revealed features which support the theory of their relationship to the Vertebrates. At present a lively scientific controversy is being carried on with regard to this moot point.

POLYZOA or BRYOZOA.

The name *Polyzoa*, i. e. multiple animals, was given to this group from the fact that they live in large colonies, like the corals. By the German school they are always called *Bryozoa* or moss-animals, a name which arose from the moss-like or coral-like growths which these colonies form.

The graceful net-like frill of **Retepora** (Fig. 116), or the branching stem of **Myriozoum** (Fig. 117), may easily be mistaken for corals, to which, however, they are by no means allied. Careful observation has shown that the little animals which form these growths, and live together in colonies, are very different from, and more highly organized than, the polypes of a coral.

The Polyzoa are widely distributed in all seas and present a wonderful variety of forms. A kind very common on the British coast and well known to all visitors to the sea-side is the leaf-like growth of **Flustra**, the sea-mat, the colour and texture of whitey-brown paper.

CRABS, LOBSTERS, SHRIMPS, BARNACLES etc. (CRUSTACEA).

These animals form a peculiar and very strictly defined group. Contrasted with the quiet and dreamy lives of the brightly coloured corals and the annelids, with the monotonous movements of the apathetic fishes, and with the lazy mollusks and echinoderms, the active and often comical movements of the different kinds of Crabs are very attractive; and we soon discover that the mental faculties of these creatures far exceed those of most other marine animals. In making this statement we have in mind chiefly the short-tailed Crabs and their allies, which are found in tank Nr. 23; but as most people are better acquainted with the long-tailed Lobster, we begin with the latter, and try to explain the other forms by comparison with the better-known animal.

The Lobster, **Homarus vulgaris** (Fig. 163), is, on the whole, an enlarged copy of the fresh-water crayfish; and visitors will easily recognize, from examining the large specimens in the Aquarium (tank Nr. 6), what are the principal features of its organisation. The body is divided into an anterior part, consisting of head and chest, which is really jointed but covered on the upper surface by an unjointed shell (*carapace*); and a posterior part, composed of a number of rings forming the "tail" of the Lobster, which terminates in a fin composed of broad, flat plates. The anterior portion bears the stalked eyes and two pairs of antennæ or feelers, one pair very long, the other shorter and forked. Behind these, and on the under surface is the mouth, furnished with six pairs

of appendages or feet modified for purposes of mastication. Of these first we have a pair of mandibles followed by two pairs of maxillæ, forming the "jaws" of the Lobster. Then there are three pairs of "foot-

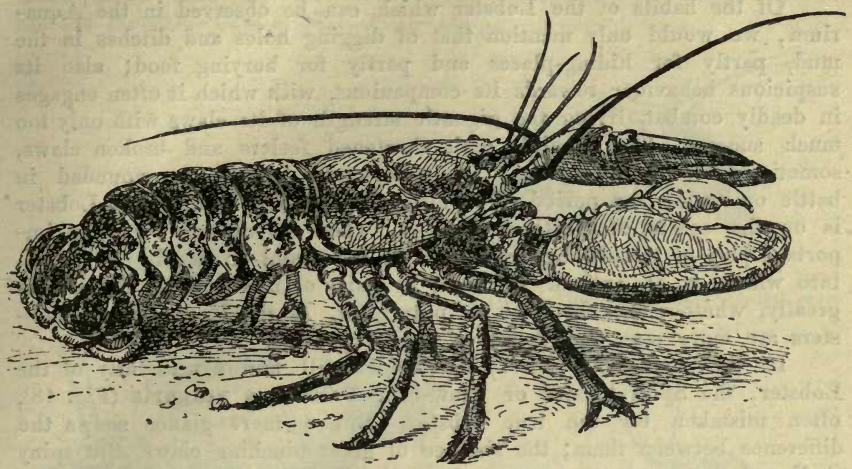

Fig. 163. *Homarus vulgaris*, 1/2 nat. size.

jaws" or maxillipedes, used by the animal to hold and turn about his prey or food, while the jaws proper are employed for biting and chewing. Behind the foot-jaws we find five pairs of walking-legs, the first three pairs of which end in pinching claws. The claws of the first pair of these walking-legs are of immense size and strength, and serve as weapons of attack or defence. The tail also bears a pair of limbs on each joint; they are termed the swimming-legs, but serve in the female Lobster to carry the eggs.

If we observe the Lobster more carefully, it seems to be constantly fanning itself with the feathery tassels on its foot-jaws, and often performs similar movements with its abdominal legs. This is its method of breathing. Just as man renews the air in his lungs by the contraction and expansion of his chest, so the Lobster, by these movements of its feet, causes fresh water to flow to its gills, which lie under its shell at the base of the legs. Another noticeable action is the constant twitching of the smaller pair of feelers; these probably serve as olfactory organs, while the larger ones are the organs of touch.

An important event in the life of a crab or lobster is the annual moult, when the animal literally creeps out of its shell, or as one might say: "jumps out of its skin". At these periods a crack makes its appearance at the hind end of the carapace, and through this the Lobster has to work its way out; first the tail, and then the head and body, being withdrawn from the old shell. It is a troublesome and often dangerous operation, as all the appendages have to be drawn out including the large claws, the eyes, the antennæ and the jaws; even the wall of the stomach has to be renewed! Often the animals have to sacrifice one

or both claws, and they are in great danger until the new covering has hardened sufficiently; so that they instinctively seek a place of retreat during this operation. Uninjured specimens which have just shed their skin, look very handsome in their new and bright apparel.

Of the habits of the Lobster which can be observed in the Aquarium, we would only mention that of digging holes and ditches in the mud, partly for hiding-places and partly for burying food; also its suspicious behaviour towards its companions, with which it often engages in deadly combat, trying the gigantic strength of its claws with only too much success. The invalids with shortened feelers and broken claws, sometimes seen in the tanks, are unfortunate individuals wounded in battle or during the period of moulting. — The real home of the Lobster is on the coasts of Northern Europe, where its capture forms an important part of the fishing industry. It is caught in creels or "pots", into which it is enticed at night by baits of meat; these it relishes greatly, whether they be fresh or putrefying. In the Mediterranean Lobsters are more rare, and therefore more expensive.

In the next tank (Nr. 7) the reader will find a near ally of the Lobster, the Spiny-lobster or Craw-fish, **Palinurus vulgaris** (Fig. 48), often mistaken for the true Lobster. But a mere glance shews the difference between them; the absence of great pinching claws, the spiny shell and the enormous antennæ immediately strike the eye of even the casual observer, and further comparison will reveal a host of less obvious differences. In their habits both animals agree, but the Spiny-lobster is more sociable and more lively; it likes to climb the rocky sides of the tank, which it does with great agility, and it feeds on shell-fish, which it cleverly opens with the strong claws of its first pair of legs. It is much more common in the Mediterranean than the Lobster, and is caught on all the rocky coasts of the Bay of Naples. It lives for a considerable time in captivity.

An allied form is the Flat-lobster, **Scyllarus latus** (Fig. 47), a clumsy animal which spends the greater part of its life in some crevice of the rock. Its broad back is generally covered with mud and brown algæ, and is often mistaken for a stone. It uses its front pair of feelers, shaped like two broad shovels, as weapons of defence; and whilst feeding it covers its food with them. In tank Nr. 23 the Lesser Flat-lobster, **Scyllarus arctus**, is often to be found; a more brilliantly coloured and livelier fellow.

Of the smaller long-tailed forms we would mention the Shrimps and Prawns, such as **Crangon** and **Palaemon** (Fig. 147), remarkable for their lively jumping. They inhabit all the rocky coasts in large numbers, and are the staple food of many animals: in the tanks Nr. 20 and 23 of the Aquarium they are largely used for feeding purposes. Their movements when walking or swimming are easy and graceful, and they are so sensitive that they feel the least disturbance of the water and respond to it by tremendous leaps.

Two rare Shrimps, not always present in the Aquarium are **Stenopus** (Fig. 133), and **Penaeus** (Fig. 132). The latter is exceedingly palatable, and, as it has a very thin skin, would be very valuable as an

article of food, if it were only a little more common. In the Bay of Gaeta it is largely caught under the name of "mazzacuogna".

We now turn to a curious group intermediate between the long-tailed forms, Lobsters and Shrimps, and the short-tailed Crabs. These are the **Hermit-Crabs** (Figs. 164—166).

Fig. 165. *Pagurus striatus*, 1/2 nat. size.

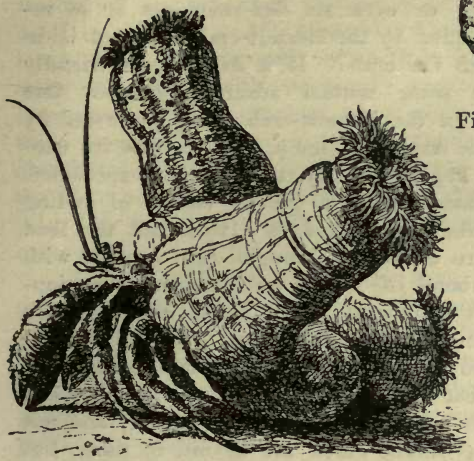

Fig. 164. *Pagurus striatus*, in a whelk-shell and bearing three Anemones, 1/2 nat. size.

Fig. 166. *Eupagurus Prideauxii*, in a shell and bearing the Anemone *Adamsia palliata*, 1/2 nat. size.

A whelk-shell walking about on crab's legs and carrying sea-anemones on its back — such is the impression made on anyone looking for the first time at a Hermit-crab (tank Nr. 23). This droll figure fascinates us at once and creates in us a desire to know something more about it. The problem is simpler than it seems, and has the following explanation. The Hermit-crabs live in deserted whelk-shells. When they escape from the egg they are just like the young long-tailed prawns; but very soon their previously straight tail begins to twist itself spirally, and the time has come for the small animal, which is scarcely half an inch long, to look out for a shell. If it finds an empty one suitable for its size, it puts its tail into it; but if it does not, it first eats out the whelk and then takes possession of the shell. In the course of many generations the hind portion of the body has become so accustomed to a borrowed covering, that it is quite soft, and resembles an unjointed sack (Fig. 165) possessing at its extremity a pair of rudimentary legs; with these it holds so fast to the shell that in trying to extricate the animal you may very often tear it to pieces. The shell thus serves as a protection, and is usually so large, that the Hermit-crab can withdraw

itself entirely from view in case of danger. As it grows, it must from time to time change its dwelling, when the latter becomes too small; and this it does with great circumspection. When it has found a shell suitable for its purpose, it first examines it carefully all over, poking its claws far into the cavity so as to make sure that there is nothing suspicious lurking within it; then, if all is right, it cautiously prepares to effect the removal. It gets hold of the shell with its claws, places it in an upright position with the opening toward itself, and with one quick dart forsakes its old shell, and slips into the new one, as if it well knew what a tit-bit its soft juicy body would be for a hungry fish.

But why should often three or even six Sea-anemones be so regularly attached to the shell occupied by the Hermit-crab, and yet be in no way organically connected with the crab? It is evidently a friendly alliance which has sprung from some mutual advantage gained; this consists, so far as we can see, in the Hermit-crab being protected by the poisonous stinging-cells of the Anemone (see p. 56), so that its enemies (turtles and cuttle-fish) are kept at bay by the pain they experience. The Anemones, on the other hand, have a greater chance of finding food; as they need not wait, like those fixed to a rock, till the food comes within their reach, but are constantly brought into contact with all kinds of animals by the vagabond life of the crab, and may occasionally catch some bits of the crab's own meal. This is the case with the beautifully purple-spotted Anemone **Adamsia palliata** (Fig. 166), which is always fixed to shells inhabited by the **Eupagurus Prideauxii**, and is so placed that it can catch what falls from the lips of the crab. But the most wonderful thing is that the crab knows its friend, and not only tries to put anemones on shells which are devoid of them, but actually takes its companions along with it, when it changes its house! Observations and experiments have placed this beyond all doubt, and prove this alliance to be one of the most remarkable known among lower animals.

The life of the Hermit-crabs in the Aquarium is rich in varied and amusing scenes. The droll fights of the little troop, the way they tumble about, flee and follow each other up, the impudent seizures of some and resolute defence of the others during the common meal invariably excite the laughter of the spectator, who is often greatly surprised at the artful and calculating ways of the little creatures. In these habits the Hermit-crabs rank next to the true Crabs, to which we will now turn our attention.

In the Hermit-crabs we noticed a retrogression in the rudimentary development of the tail, brought about by their mode of life. In the short-tailed *Crabs* (Brachyura) this retrogression has gone still further, but has been accompanied by an increase in agility. Here the large portion of the body which forms the tail of the lobster, is reduced to a small round or triangular plate which is doubled up under the stomach-region and is therefore not seen from above. The anterior part of the body is laterally expanded and is mostly of a roughly triangular or square shape; the well known Shore-crab may serve as a type.

To begin with, we would mention the Crabs with a triangular

body. The first point which will attract notice in these, is the curious way in which they are covered with all sorts of foreign substances; thus **Pisa** (Fig. 146) carries quite a forest of small algæ and colonies of animals (Polyzoa and Hydroid-polypes) on its back and legs; **Inachus** (Fig. 145) carries about on its slender legs plants, sponges, and ascidians; in fact the more crabs we examine the greater is the variety of toilets that we see. And what is their use? They afford the best possible concealment from enemies and from prey. For all these objects have not fastened themselves on the crabs, but have been artistically placed there by the crab itself — we dare hardly say intentionally — but by reason of an inherited instinct which impels the animal to disguise itself in this way. All triangular Crabs are exceedingly slow in their movements, and dressed up in this way they resemble most closely a stone overgrown with sea-weed; especially as they have the habit of remaining quite motionless when alarmed. The apparatus for affixing these foreign bodies consists of a number of hooked bristles which are distributed all over the shell; there the crab deftly fastens with its claws the algæ and other ornaments. The Larger Spider-crab, **Maja squinado** (Fig. 49), covers its back with small stones and shells instead of with sea-weed.

Lambrus (Fig. 143) departs from this custom and depends more upon its large and strong claws than upon concealment.

Some of the Crabs with a square body have similar habits. **Dorippe lanata** (Fig. 142) gets hold of any living or dead object within its reach, holds it above its body with the claws of the two last pairs of legs, and walks about thus concealed. Sea-cucumbers and ascidians, crabs and starfishes, fishes' heads, bits of glass or wood, in fact anything and everything which can serve as a shield, is annexed without further ado. Naturally, when the desired shield happens to be a living animal, there often ensue very laughable conflicts between the instinct-obeying crab and its reluctant victim.

Dromia, the Woolly-crab (Fig. 167), covers itself so completely with an orange-coloured sponge (Suberites, p. 55), or with a colony of compound ascidians, that, if you look at the animal from above only its legs are visible. Here, too, the living coat, which increases in size as fast as the crab, is held on by means of the two last pairs of legs.

Fig. 167. *Dromia vulgaris* covered with a sponge, $^1/_2$ nat. size.

The crabs with a round body behave very differently, for they are extremely clean. **Calappa**, the Bashful-crab (Fig. 138), seeks protection by burying itself in the sand. With a few vigorous movements of its large shovel-like legs it sinks itself up to the eyes in the sand, and carefully surveys the country from this retreat. **Ilia** (Fig. 141) acts in the same way.

The most highly developed forms of this group are the Shore-crabs,

of which we will only mention **Carcinus** (Green Crab, Fig. 137), **Eriphia** (Fig. 144) and **Lupa** (Fig. 139). Their agility and slyness are surprising, and, together with their power of living and moving on land, point to a further progress in their organisation. Those who have tried to catch one will remember the difficulty in obtaining even one of a hundred, and will have noticed how cleverly the little fugitive availed itself of every hiding-place, and how boldly it defended itself when finally driven into a corner. The strong Eriphiæ are especially ready to fight, and with their strong claws they pinch violently every thing which is held out at them. In the Aquarium they have been seen to break thick glass tubes.

Out of the water all Shore-crabs can live a considerable time and move about with as much agility as in their native element.

Besides all these Crustaceans with five pairs of legs (*Decapoda*) we must refer to a genus belonging to the *Stomatopoda*. This is the Mantis-prawn (**Squilla mantis**, Fig. 148) a slender, agile, and predacious animal which in the shape and position of its claws greatly resembles a well known insect, the Praying Mantis (*Mantis religiosa*). Its legs have claws that close like the blades of a penknife on its handle; and it can dart them at its victim with great force and velocity, like the predacious insect which it resembles. The Mantis-prawn is a very clean animal, and almost constantly occupied in carefully cleaning all parts of its body. It may be seen in all sorts of attitudes, performing its toilet. Now the eyes and feelers, now the mouth and its appendages, now the legs and joints of the body are brushed and stroked, till no foreign particle is left adhering to them.

Up to the present we have dealt with Crustaceans of considerable size, which at once strike the eye; but now we must spend a little time over their smaller kin.

The large group of the Crustacea comprises such a variety of forms, that only those zoologists especially studying this group have a conception thereof, and by far the greater number of species are unsuitable for exhibition in an Aquarium. This is due in part to their smallness, often accompanied by entire transparency, so that they cannot be seen with the naked eye; in part to their secluded habits. We must confine ourselves to those more striking forms which are occasionally exhibited in the Aquarium.

Almost all the year round most of the tanks, especially Nr. 7 and 11, contain swarms of very minute, lively shrimps, which play about over the sand like a swarm of flies. These are not the young of some larger shrimp, but fully grown animals, the Opossum-shrimps or *Mysidea*. They are remarkable for having their organ of hearing quite in their tails, and each leg terminating in two prongs. The higher forms of crabs have such "bifid" feet at the earlier periods of their life and have probably sprung from some form similar to the Mysidea of to-day.

Out of the group of the *Isopoda* (of which the wood-louse is a typical example, being an Isopod which has taken to terrestrial life) visitors may often see the parasitic forms **Anilocra** and **Cymothoa** (Fish-lice) fixed to various fishes. They are attached to the head, the

eyes, and the tail of the fish by means of their mouth-appendages and the sharp sickle-shaped legs (7 pairs); or they are attached within the gills or the throat of the fish and suck its blood; they may attain the length of a couple of inches. They fix themselves so firmly that no endeavours of the tortured animal can dislodge them. The females carry about their eggs in a special brood-pouch, on the under surface of their body, till the young ones are hatched. A curious fact worth noticing is that all females have in their youth been males; the new born animals are not divided into the two sexes but, figuring as males in their early life, when they have grown older they take upon themselves the duty of producing eggs.

Most genera of the *Amphipoda*, the next group, of which the reader perhaps knows the common Freshwater Shrimp (Gammarus pulex), are marine forms. **Phronima**, the Hermit-screw (Fig. 168), is especially interesting. It is a perfectly transparent pelagic form, and curiously enough makes use of the young Pyrosoma (see p. 85) as a dwelling, eating out its centre so as to form a small barrel. It fastens itself to this house by means of its front legs and protrudes the hind end of its body, the legs of which perform rapid strokes, which propel the animal together with its house through the water. This invertebrate Diogenes uses its transparent tub as nursery too; not only fastening the eggs to its wall, but keeping the young there for some time after they are hatched. It is caught on the surface of the sea, together with jelly-fish and other "pelagic forms" especially in the months of winter and spring, and will be found occasionally in tank Nr. 20.

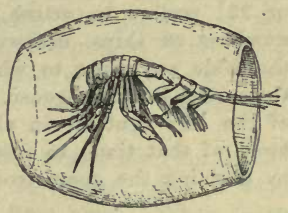

Fig. 168. *Phronima sedentaria* in its barrel.

The lowest division of the Crustacea shown in the tanks is that of the *Cirripedia* ("Tendril-feet"), popularly termed Barnacles, which are externally so unlike shrimps or crabs, that they have only in recent times been properly understood. Even Cuvier looked upon **Balanus**, the Acorn-barnacle (Fig. 169) and **Lepas**, the Goose-barnacle (Fig. 131), as mollusks; and it was not till much later that their early stages, and their anatomy, revealed the fact that they belonged to the Crustacea.

Fig. 169. *Balanus perforatus* on a rock, $^1/_2$ nat. size.

The general public will therefore also experience some difficulty in accustoming its mind to the fact that these animals are undoubtedly relations of the well-known forms of Crustacea. This may be more intelligible when it is told why we suppose that the curious form of the animal, reminding one of the shell of some fixed mollusk, is due to a far reaching de-

generation. In their early youth, these animals are very small, active and free-swimming, with a pear-shaped body and three pairs of swimming-legs. This larval stage is common to all the lower forms of Crustacea and is termed the "Nauplius" stage. But after several moults this larva fixes itself by its head to some convenient object, and now the skin begins to secrete the calcareous covering, which consists of several plates completely hiding the animal, and only allowing the delicate legs to protrude from a slit-like aperture. These delicate jointed legs can be seen waving perpetually in both Balanus and Lepas, as they so serve to create a current bringing food to the mouth (see p. 53).

Balanus forms a belt all round the rocks just at the surface of the water, and these barnacles are so securely attached that they cannot be washed off by the waves. At low-tide they bear the greatest heat of the sun, lasting out till high-tide with the least drop of water, which they retain in their tightly closed shell. Lepas (when present, in tank Nr. 10 or 22) prefers to attach itself to floating objects; it is found in large numbers on ships, driftwood, etc. Its name of Goose-barnacle is due to the fable according to which they are the young of the goose called, after them, the Barnacle-goose. This myth, which is traced back to the end of the 12th century, in all probability arose from the desire of the priesthood of that time, to increase the small range of a Lenten bill of fare, by deriving the geese from marine animals.

MOLLUSCA.

The term Mollusks, i. e. soft-bodied animals, is applied to Snails, Slugs, Poulps, Bivalves and their allies, because they have no skeleton which enters into the mechanism of their movements; neither an internal one like that of the Vertebrates, nor an external one like that of many Worms and all Crustacea. Besides this point they differ from the above mentioned groups in not being jointed. Very many Mollusks are provided with a shell and have a head very distinctly marked off from the body and bearing eyes and tentacles.

We will begin with the highest group of the Mollusks, that of the *Cephalopoda* or Poulps. Their head bears 8 or 10 arms or feet, arranged in a ring round their mouth, and this has given rise to their scientific name. Most striking of these in the Aquarium is the eight-armed Devil-fish (ital. Polpo, the Polypus of the Greek) **Octopus vulgaris** (Fig. 73 and 74), which is very common on the rocky coasts of the Mediterranean. Its body has the form of a round bag, half of it is hollow and performs regular respiratory contractions; at one end is a toad-like head provided with two large eyes, and with eight arms united at their base by a web; each arm bears two rows of suckers. Hidden in the middle of the arms is the mouth furnished with a pair of jaws, having the form of a parrot's beak. As the animal breathes, there may be noticed a membranous flap which alternately opens and shuts, and laterally a projecting tube ("funnel") which also opens and shuts, its movements alternating with that of the membranous flap. The flap allows the water to enter the "mantle-cavity", or hollow part of the bag, in

which hang the gills; the water which has been used for respiration is then forced out through the "funnel", the flap being kept closed. This alternating movement serves also as means of progression, the water which is being forced out, propelling the animal with its hind-end foremost (Fig. 73). The arms are used for crawling and climbing, they serve also to catch and hold the prey with their suckers. Food consists chiefly of crabs which after being caught and carried to the mouth by means of the arms, are quickly paralyzed by a poisonous fluid secreted by the salivary glands. Then the juices are sucked out of the body, the solid parts not being swallowed. The Octopus are strong and daring robbers, lying in wait for their prey in the crevices of the rocks. In the Aquarium they pile up large stones into a heap behind which they conceal themselves, ready to pounce out on the unwary fishes; their power of changing their colour and of producing all sorts of warts and wrinkles on their otherwise smooth skin, enables them to counterfeit so closely their surroundings, that they can only be distinguished with difficulty. They are caught all round the coasts of the Mediterranean, allured by baits, upon which they pounce and with which they are hauled up. They are found in all Neapolitan fish markets, as they are often eaten, and the arms of young specimens are especially esteemed.

A very near ally of Octopus is **Eledone moschata**, the Musk-octopus, much smaller and with only one row of suckers on each arm. They are very shy and try to hide themselves from view. When taken out of the water they give out a strong odour of musk. As they are frequent in occurrence they are often brought to market, but are generally only eaten by the common people.

One of the most interesting and most important of the Cephalopods is the Sepia or Cuttlefish (**Sepia officinalis**, Fig. 78). Their body is oval, somewhat flattened, and with a membranous fin running down both sides. Beneath the dorsal skin is the "cuttle-bone", found often on the English coast and given to captive canaries to sharpen their beaks. The eight arms are much shorter than those of the Octopus and are generally carried closely applied together; between them is hidden another much longer pair of arms which can be shot out to catch crabs or fish.

The most noticeable characters in Sepia are the excretion of an inky fluid and the change of colouring in the skin. Both of these they have in common with the other Cephalopods, but they make more frequent use of them. The sepia used by artists is the product of a gland, the so-called ink-sack, the contents of which can be squirted out through the funnel; a small quantity is enough to suddenly envelope the animal in a black cloud, which hides it from its pursuer. The ink is extracted, dried and brought to market; even that of fossil forms can still be used. — The wonderful play of colours on the living animal is due to large cells (chromatophores) which are situated in the skin and are filled with finely divided dark colouring matter; as these cells contract (become globular) and expand (become flat), a continuous change of colours takes place; stripes, spots and markings make their appearance and disappear according as the animal is at rest or is irritated. The Cuttlefish have

complete control over this change of colours; this is seen from the protective colouring, which they assume when they lie on the sand or on dark rocky ground; in either case they can hardly be distinguished. — The males court the females with great ardour and in their excited state produce most brilliant colours over their body. The female lays large, black, pear-shaped eggs and fixes them singly to corals and algæ, usually closely together, so that they form large grape-like clusters (often visible in tank Nr. 19). As soon as the young are hatched they shew their proficiency in changing their colouring and emitting the sepia.

The Cuttlefish is an important article of commerce: its flesh is eaten, the cuttle-bone is used for polishing wood and as tooth-powder, and the ink commands a high price.

The Calmar or Squid (**Loligo vulgaris**, Fig. 15), very common in winter, is unfortunately too delicate for the Aquarium. Like a swarm of birds, slowly beating their fins, these transparent animals swim backwards and forwards, without turning round, until they die; usually only a few days after their capture. The slightest disturbance puts them in a state of great alarm and causes their milk-white bodies to show the most lovely red tints. They can be fed with small shrimps and will be seen to use their long arms like the cuttlefish. Their flesh is eaten very generally; the "pen" — corresponding to cuttle-bone — is translucent, flexible and shaped like a feather. Like Sepia they secrete ink; hence the Italian name of Calamajo (ink-pot).

It is certain that the Cephalopoda can attain enormous dimensions, and from occasional specimens have probably arisen the legends of the Kraken, if not of the sea-serpent. Thus Pliny relates a story of an animal of this kind, which came at night to the fish-tanks of Carteja, and frightened the dogs away by its snorting and its terrible arms. The head which was shewn to Lucullus, was as large as a barrel holding 15 amphoræ of wine, and its arms were so thick, that a man could scarcely clasp them and measured 30 feet in length, while the suckers they bore contained an urn full of water. Montfort tells of an Octopus that tore a couple of sailors from the rigging of a ship near St. Helena; the end of one of its arms, which caught in the tackle, was hewn off and measured 25 feet. On the coast of Newfoundland in 1875 an extraordinary number of such gigantic animals were found either dead or dying on the surface of the sea. On the average they must each have weighed half a ton; their long arms reached a length of 40 feet. On the coasts of Alaska, Japan, New-Zealand and on the Pacific island of St. Paul similar monsters have been observed; a gigantic arm is in the British Museum.

Like the Cephalopods, the *Gastropods* (Snails and Slugs) have a head distinctly marked off from the body; it is devoid of arms, but there is present a so-called foot, i. e. a portion of the body is flattened out like the sole of a foot and is used for crawling, which is generally the only means of locomotion possessed by the Snails. In many forms the viscera are contained in a spirally coiled, calcareous shell, the snail-shell, into which the rest of the body can be retracted. The shell is secreted by

the mantle, a flap of the skin, and is held on the animal by means of a spiral muscle. The foot frequently carries a horny or calcareous lid, which closes the mouth of the shell when the body of the animal is retracted. The collections of shells in museums give some idea of their beauty and brilliant colouring, as also of the great variety of their forms; most are marine. The most important ones found in the Aquarium are the following.

The Ear-shell, **Haliotis** (Fig. 126), has a very flat ear-shaped shell with a large opening, and a row of holes through which tentacle-like processes of the foot protrude. Internally the shell is coated with the most lovely mother-of-pearl, and is therefore frequently used for ornamental purposes.

The Helmet-shell, **Cassis** (Fig. 22), is also commercially a very important shell. The shells of the largest specimens are used in the cutting of the well-known cameos. Suitable pieces are sawn out of the shell and their outer surface ground down, while the inner surface remains in its natural condition; the relief is worked out of the many-coloured layers by means of a graving tool such as is used for cutting corals.

The Snail **Natica** (Fig. 23) possesses in so high a degree the power to take up water into the cavities of its foot, that it becomes three times as large as it is in the normal condition. It can also crawl at a fast pace, contradicting the proverbial slowness and laziness of its group.

Murex (Fig. 21) is represented in the Aquarium by several species, which played an important part in former days, furnishing the Tyrian purple which was used by the ancients for their festal garments. The colouring juice, the secretion of a gland of these snails, is white or pale yellow when fresh, but turns yellow and green when exposed to sunlight, and finally brilliant purple. The shade of violet produced, depended on the amount of the dye used, so that the dyer was able to produce any tint. In ancient times this dyeing industry was practised all over Italy and Greece. Now-a-days it has entirely disappeared; although this colouring matter has been proved so sensitive to light, as to be well suited for printing photographs on silk.

The "Triton's horn", **Tritonium** (Fig. 19), is a large, clumsy snail with long tentacles and a long extensible proboscis. It crawls about slowly at the bottom of the sea at considerable depths, and lives on animal food. The heavy shell was used by the Romans as a martial horn, and is still used by the people as a signal. For this purpose the tip is cut off, and the opening thus formed is the mouth-piece of the trumpet. The murmuring sound, like that of the waves, which is heard on holding this and other large shells to the ear, is very likely due to the resounding within the coiled shell of the numerous waves of sound always present. In quite still places no noise is heard in such shells.

The Tun, **Dolium** (Fig. 20), is the largest snail of the Mediteranean, with a thin, rounded shell. Its body has dark brown spots on a white ground and is provided with a large proboscis. A curious fact in connection with this animal, is that its large salivary glands secrete a fluid which contains over 3 per cent of free sulphuric acid and about

1/2 per cent free hydrochloric acid. The animal squirts out considerable amounts of this acid fluid in order to soften the hard calcareous skin of the Echinoderms which it eats, and perhaps also in self-defence; it is still a puzzle how these strong corrosive acids are produced by the animal and how they can be stored up.

An interesting animal is the Worm-shell, **Vermetus** (Fig. 125), from the fact that it is not able to move about freely like the other snails, but is fixed to one spot. At first sight its shells are just like the calcareous tubes of Protula (see p. 66). But on closer inspection may be recognized the head of the snail with its two short tentacles, very different from the brightly coloured gills of the worms. These animals feed on the small crustacea and worms in their neighbourhood, and when alarmed, they withdraw themselves into their tube. To the inner wall of the latter they also fix their eggs; from these free-swimming larvæ are hatched, which afterwards fix themselves to some rock.

Allied to the above mentioned forms is a group of Mollusks which differ in having their gills attached behind their heart instead of in front. They are devoid of a shell or only possess a very small one which is hidden by the mantle, as in the land-slugs. This group includes:

The Sea-hare **Aplysia** (Fig. 16), a fairly large dark-brown animal with two pairs of tentacles, the posterior pair of which are carried erect and are something like the ears of a hare. The mantle is continued into two large wing-like flaps. They generally creep about lazily over the rocks; but if they want to swim, they begin to flap their "wings", till they have raised themselves from the ground. Once afloat they swim very well and fairly fast, but not for long. When annoyed they give out a very beautiful violet, and also a white liquid, which serves as a protection like the sepia of the Cuttlefish. The ancients already were aware of the poisonous nature of the white secretion, for their writers record its use for the preparation of poisonous and magic draughts; those who partook of these were supposed to linger on in agonies until the Sea-hare died. The Sea-hares live on vegetable matter and graze in hundreds on the fields of sea-weeds. It is interesting to see them when stones covered with sea-weeds are brought into their tank; they creep forth from every corner to get at the food, and in a few hours the stones are bare. With the help of this food they live a long time in the Aquarium; they grow to considerable size and often lay their eggs in long thread-like masses, of yellow or violet colour, on the walls of the tank. — In tank Nr. 3 may be further observed the two flattened snails **Pleurobranchus** (Fig. 17) and **Umbrella** (Fig. 18). The shell of the latter is quite flat and the foot relatively very high.

One of the finest animals belonging to this group is **Tethys** (Fig. 101). Its body is white and semi-transparent, and carries an exceedingly broad head. On both sides of the back are attached the delicate transparent gills, and besides these there are large spotted appendages which fall off very easily and were therefore formerly considered as parasites. This animal, like other pelagic ones is only occasionally found in the Aquarium; the fishermen scoop them up from the surface of the sea with buckets. They swim by throwing their head first to one side and

then the other, the body helping with violent writhings. They live only a few weeks in captivity.

Equally remarkable but of smaller size is **Aeolis** (Fig. 102). **Doris** also (Fig. 100) with its dorsal tufts of feathery gills belongs to this group. Frequently they may be observed laying eggs, which are generally enclosed in a mucilaginous mass and arranged in ribands or strings.

Allies of the snails form a portion of the pelagic fauna (see Note on p. 62). Swimming among the transparent Medusæ and Ctenophora, we have the curious Keeled Snails (Heteropoda) and Sea-butterflies (Pteropoda). Especially in spring and in autumn, when the sea is full of pelagic life. these two groups make their appearance; in the Aquarium, however, they only last a very short time (Tank 20) and belong therefore to the rarer guests. Of the *Heteropoda* we would mention **Pterotrachea** (Fig. 170), a perfectly transparent, long and thin animal with a curved

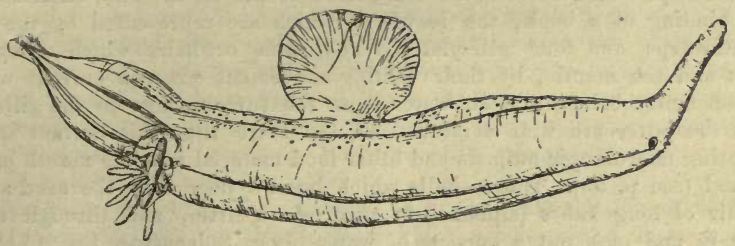

Fig. 170. *Pterotrachea coronata*, $^1/_2$ nat. size.

proboscis, and a fin of the shape of an axe-head. This fin is in reality the foot of the snail. The visceral hump is of a brown colour with a silvery sheen. The animal swims very actively but, curiously enough, with the fin uppermost, the body giving energetic strokes from side to side and the fin swinging to and fro like a pendulum. Their protusible tongue is armed with sharp hooks and with it they catch the lesser pelagic animals. The same might be said of **Carinaria** (Fig. 98), which attains a considerable size and has a delicate transparent shell.

The *Pteropoda* are curious, because externally they differ in almost every point from the typical Snails. The head is only indicated by the mouth and the rudimentary tentacles. The body is often covered by a delicate shell. The most striking feature is a pair of large wing-like fins, which are attached to the head or neck and are used by the animals as wings; hence the Neapolitan name *farfalle di mare* (Sea-butterflies). The most common genus **Hyalaea** (Fig. 99) has a delicate horny shell of brownish colour, and large fins which are perpetually beating. It appears in swarms, but only lives a day in the Aquarium (Tank 20).

The oysters, mussels etc. belong to the Bivalves (*Lamellibranchia*), the lowest group of the Mollusks. They are distinguished from the snails by their shell, which consists of two pieces which are hinged, and

are brought together by means of one or two muscles, but open by an elastic external ligament when the muscles are relaxed. The absence of a head is a characteristic feature of this group. The protrusible "foot" (Fig. 171 on the left) serves as organ of locomotion. The body is

Fig. 171. *Solecurtus strigilatus*, 1/2 nat. size, on the left the foot, on the right the respiratory tubes.

covered on both sides by the leaf-like gills, and the latter by the two mantle-flaps which secrete the two pieces of the shell. This shell is like the binding of a book, the leaves of which are represented by the two mantle-flaps and four gill-plates. The cilia or hairs which cover the gills and the mantle, by their beating movement create a current which is constantly bringing fresh water from the surroundings to the gills, so that the latter are well aërated. At the same time this current serves to bring microscopic animals and other food material into the mouth of the animal (see p. 53). Those shells which burrow deep into the sand allow a pair of long tubes (siphons) to protrude a little, and through these take in and pass out a current of water (e. g. Solecurtus, Fig. 171). — The Bivalves are generally either fixed permanently like the oyster, or they burrow to some depth into the sand; a very few can swim about freely or can jump. (With the exception of **Pecten** the Bivalves will be found in Tank Nr. 22).

The most important example is the Oyster, **Ostrea edulis** (Fig. 127). Everybody knows its unpretentious shell, which is usually fixed to a rock by the thicker half. In their youth the Oysters swim about freely in the sea, but they soon settle down and secrete a substance which glues the shell to the rock. The "foot", which in most Bivalves is the chief organ of locomotion and assumes considerable dimensions, becomes quite rudimentary in the Oyster, where it is no longer used. Each Oyster is both male and female. The eggs may number several millions and ripen in summer. The young live in the mantle-cavity of the parent, till their shell is sufficiently strong to allow them to "swarm" and fix themselves.

The Oyster lives in all seas with the exception of the Baltic, and often makes its way up into the rivers. In Europe and North America they are artificially reared on "Oyster-beds", as they are not only a luxury but (especially in England and America) one of general consumption. The number of Oysters eaten in England in a year is said to be 2000 millions, while America consumes 4000 millions. Artificial culture was already practised by the ancients; at the tables of Imperial Rome oysters were never wanting, and epicures declared the best to

come from the lake Lucrinus at Bajæ. Brindisi, too, was one of the principal localities, as it is even at the present day, for the culture of the Oyster.

The Edible Mussel, **Mytilus edulis** (Fig. 25), has the well known almost triangular, blue-black shell. The animal has a so-called byssus-gland with which it produces long horny threads, which fasten it to rocks and woodwork. If it wants to leave its home, it produces a new byssus with its finger-like foot and then it tears the old byssus away; by repeatedly doing this it moves very slowly onwards. It flourishes best in northern seas, where it is extensively collected and cultivated; for this purpose trees are let down into the water and from time to time drawn up, and the Mussels adhering are removed.

Pinna (Fig. 128) is a large, thin-walled, club-shaped shell, which is fixed in the mud by its narrow end. It also possesses a byssus which, however, is much longer and composed of finer threads than that of the Mussel. These silken threads were formerly used for the manufacture of gloves, stockings and even entire garments; in the 18th century there existed at Naples and Sicily large works for spinning them. The shells of Pinna also yield occasionally pearls, which, however, are of very little value. The fable of the crab, *Pinnotheres*, acting as watchman to its host the Pinna, has been believed from the most ancient times up to the present day; similar crabs are known to frequent some other Mollusks, Ascidians and Sponges. It is doubtful whether in any case the host derives benefit from its lodger.

Avicula (Fig. 129) is remarkable as a very near relation of *Meleagrina margaritifera*, the Pearl-oyster, which produces the finest pearls. These are nothing more than secretions of carbonate of lime with which the animal covers up extraneous bodies (grains of sand, etc.), which irritate its body. Each pearl contains at its centre some such object, and in this way man can cause the production of pearls, a fact of which the Chinese have taken advantage to make pearls of various forms.

A shell of interesting habits is **Lithodomus** (Fig. 27), which is always found in holes, in rocks or coral reefs. The animal is a favorite delicacy and often appears in the markets. It is not yet understood how it works its way into the stone; its shell is perfectly smooth and so it cannot file its way in, as the Piddock, **Pholas** (Fig. 26), does with its rough shell armed with hard ridges; probably Lithodomus secretes a fluid which acts upon the limestone and dissolves it. The holes they make are quite smooth inside.

The Temple of Serapis at Pozzuoli has made these shells of interest, as its columns have a zone 6 feet high marked with the holes formed by these shells. It is hence concluded that the temple must have sunk under the level of the sea for a time and then have been raised again.

Deeply buried in the sand may be found the Razor-shells, **Solen** (Fig. 172) and **Solecurtus** (Fig. 171), which are sought after as delicacies. They are sold on the market with other edible shells as Fruits of the Sea (*Frutti di mare*), and are eaten raw.

While all the above named bivalves afford examples of the still-life

of the ocean, the Cockle and Scallop are by no means slow of movement. The Cockle, **Cardium** (Fig. 154), is a genus comprising many species; it derives the Latin name from the form of its shell. The animal has

Fig. 172. *Solen vagina*, $^1/_2$ nat. size, on the left the foot, on the right the respiratory tubes.

a long, bent foot of a brilliant red colour, and knows how to make good use of it. It presses it on the ground, stiffens it out by forcing blood into it, and in this way clears a distance of several feet; this jumping seems a most surprising movement for a shell to make, but it is not solely restricted to the Cockles. It can also burrow very rapidly in the sand, using the bent foot as a hook. It is a very toothsome shell-fish and is collected in enormous quantities on the British coasts.

The Scallop is one of the most widely known shells, the largest species, **Pecten jacobaeus** (Fig. 24), having been used for ages by the pilgrims returning from the Holy Land, as a decoration of their hats and dress. The animal bears all round the margin of the mantle numerous short tentacles, and small beady eyes which shine like precious stones; this can easily be seen when the shell is open. Their mode of progression is remarkable. They move about in jerks, by a rapid opening and closing of their shell, the hinge being behind; when these contractions cease, they fall to the bottom again. The larger species have a flat and a concave shell, the latter is used for culinary purposes, to carry the "Ragoût fin en coquille".

TUNICATA.

Tank Nr. 4 presents a most curious picture of still-life. It contains groups of white couples of semi-transparent tubes; rough, knobbed masses like ground glass or wrinkled brown leather; or lastly red sack-like structures. Then we see green gelatinous masses, and on the sides of the tank are incrustations with delicate star-like markings. And all these curious forms scarcely reveal their animal nature; yet on closely observing them, the larger ones exhibit from time to time a closing and opening of their two large pores. They are called Sea-squirts or *Ascidians*. This apparent bed of curious plant-like growths is so completely misunderstood by the uninitiated, that we shall give a short account of their development and structure.

Their most obvious characteristic is the "tunic" from which they derive their name; it is a protective covering, consisting of a substance closely resembling the cellulose of plants (see p. 54). In **Ciona** (Fig. 28) it follows the shape of the animal, which is thus seen to consist mainly of two tubes, a longer and a shorter, bearing respectively the mouth and the outgoing pore. In **Cynthia** (Fig. 30) only the necks

of these tubes project, while in **Phallusia** (Fig. 29) only their apertures are visible, the thick knobbed tunic giving an irregular outline. Food and oxygen are obtained in all the group by means of an almost continuous current (cp. 53) which enters the mouth and issues from the outgoing pore, passing from the one to the other through innumerable gill-slits in the throat, on the walls of which vibrating hairs drive the water along; an outgoing chamber surrounding the throat communicates with the outgoing pore. Into this chamber the eggs and excrementa are also discharged, the intestine being coiled in the comparatively small solid part of the body.

The Ascidians are nearly all sessile animals; they either remain separate individuals like the above described Phallusia, the semitransparent **Ciona** (Fig. 28) and the crimson- or orange-coloured **Cynthia** (Fig. 30); or they form colonies in which the individuals are connected with each other at their base by "runners" like strawberry plants; or, as in a third group, the *Compound Ascidians*, a number of individuals are united in a common covering and grouped in definite manner. To these last belong **Diazona** (fig. 31) and the various species of **Botryllus**, which form patches on the rocks of the tank; the arrangement of the individuals in the shape of rosettes can in this case be seen with the naked eye. The only free-swimming Ascidian known is the **Pyrosoma** (Fig. 96); a hollow gelatinous cylinder from which the separate individuals project like the pegs on the cylinder of a musical box. It belongs to the pelagic fauna, and helps materially to produce the wonderful phosphorescent appearance of the sea. It is only rarely seen in the Aquarium (Tank Nr. 20), being of irregular occurrence in the Bay of Naples.

The life history of the Ascidians is extremely interesting. From the egg escapes a free-swimming tadpole, with lashing tail, containing an organ which at the commencement has great similarity with the "notochord" of Vertebrates. The "notochord" is a cartilaginous rod, round which the back-bone is formed; in the lowest Vertebrates it persists throughout the life of the animal, but in the larval Ascidian it gradually decreases, and vanishes entirely when the tadpole becomes fixed. The theory has been scientifically established, that every individual in developing passes through stages, which represent the form of its ancestors; to take a simple example: the fish-like form of a frog's tadpole indicates that the ancestors of the frogs were fishes, in other words that the frogs have descended from fish-like Vertebrates. Now the young Ascidian has a notochord, an eye, and an ear: in other words, it is adapted to the life of a swimming animal; we believe therefore that the ancestors of the Ascidians were probably swimming forms allied to the Vertebrates, degraded thus sadly through the ignominy of a well-protected life.

All Ascidians are hermaphrodite, i. e. each individual is at once male and female. But besides the sexual reproduction, in which fertilized egg-cells produce the above-mentioned larvæ, asexual reproduction takes place by the process of budding, and so gives rise to the colonies.

Opposed to the sessile Ascidians we have the free-swimming *Salpæ*.

The transparency of their bodies stamps them as pelagic forms, which drift about like the jelly-fish on the open sea, and are occasionally carried by currents to the coasts, where they very often find their way into the nets of the fishermen, much against the wish of the latter. In the Aquarium they will be almost always seen in spring and autumn (tank Nr. 20) where the structure of the larger forms, such as **Salpa maxima-africana** (Fig. 173), may be readily followed. The outer wall

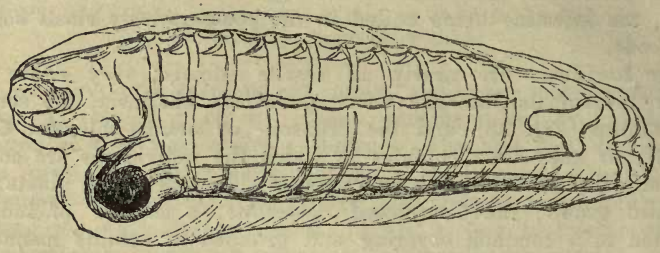

Fig. 173. Single individual of *Salpa maxima-africana*, $^1/_2$ nat. size.

of the barrel-shaped body is like the tunic of the Ascidians, and presents a hole at each end. The throat is in Salpa, however, literally nothing but gill-slits, its wall being represented only by a slanting bar (observe vibrating hairs) leading from the mouth to the stomach across the great anterior pore, or mouth, into the swimming-cavity. When this is filled with water, the mouth is closed, and the muscular bands, which surround the body like hoops of a barrel, are forcibly contracted. This contraction forces the water out through the hinder or outgoing pore and the animal is jerked forwards. It thus sucks its way through the water. At the hinder end of the body (left in Fig. 173) a brown globular mass, the stomach and intestine, will be noticed. In front of it lies the transparent heart, which in all Tunicata contracts for a few minutes from front to back and then from back to front, so that the circulation of the blood is periodically changed.

The development of the Salpæ is of great interest. The poet Chamisso, who was also a very good zoologist, was the first to observe on his voyage round the world, that in Salpa the offspring does not resemble the parent form, but the grand-parent. Thus in one species we have two forms which alternate with each other (cp. p. 61); one form he found always as a single individual, whereas the other one occurred in chains consisting of a large number of individuals. Later observations have entirely confirmed the accounts of this "Alternation of generations" of the Salpæ. In the Aquarium visitors will find both chains (Fig. 94) and single individuals (Fig. 93) of the same species; the chains are sometimes of considerable length, or they may form a closed ring (Fig. 95). The members of such a chain are completely alike, and are hermaphrodite. Their eggs never hatch into chains, but always into single individuals, which are not only different anatomically from their parent, but also never produce eggs. Instead of these latter the ovary gives rise to buds, which are small chains of Salpæ and are liberated

after attaining a certain size. Like Pyrosoma the Salpæ are phosphorescent animals.

In connection with the Tunicata we may mention the Lancelets, which are looked upon as the lowest vertebrate animals. The Neapolitan Lancelet, **Amphioxus lanceolatus** (Fig. 66), is scarcely 2 inches long, colourless and translucent; its only skeleton is a notochord; it has no head. Instead of a heart it has pulsating vessels containing colourless blood, and like the Tunicates it has a throat perforated with many gill-slits. But its development is even of greater interest to zoologists than its anatomy; for it resembles greatly that of the Ascidians (cp. p. 85) and points to a near relationship of these two forms. It is supposed that there must once have existed a group of animals possessing a notochord and gill-slits, whose descendants are now represented by three clans, (1) the Fishes and Terrestrial Vertebrates, (2) the Lancelets, (3) the Tunicates.

Amphioxus lives in the sand of flat coasts and resembles a worm more than a fish. It is found in thousands along the beach of Posilipo and similar tracts of the Bay of Naples. It was first discovered on British coasts by Mr. Couch in 1831; within the last few years several kinds of Lancelets have been found in other seas.

In the Aquarium it can only be kept, if a plentiful supply of sand be in the tank (the little open one in front of tank Nr. 10). In this it burrows immediately and only comes out at night or if disturbed.

FISHES (PISCES).

Fishes have such well-known external characters, that they will be rarely mistaken for members of the other large groups of the animal kingdom. We will only remind the reader that the "cuttlefish" are not really "fishes" in the zoological sense but mollusks, and that there are a few true fishes differing considerably from the usual form, such as the snake-like eels, the flattened rays and soles, and the graceful sea-horses.

As the fishes, like the other animals, are arranged in the Aquarium so as to suit their various modes of life, we shall also arrange our remarks to illustrate the same. Scientifically the fishes are divided into cartilaginous and bony fishes respectively, but in both groups according to their habits we can distinguish Drift-fishes, that is such forms as are always or almost always swimming, and Bottom-fishes, which pass the greater part of their life lying on or even buried in the sand, or on the rocks. This distinction cannot, of course, be carried through quite consistently, as we find all sorts of intermediate forms.

We will begin with the **Cartilaginous Fishes**, to which the Sharks, Dog-fish and Rays belong. Those in the Aquarium are chiefly Bottom-fishes, which display only very little of their life. Let us turn our attention first of all to the *Sharks*.

The word "Shark" will cause the reader to think at once of those gigantic robbers of the ocean, which have become the terror of the sai-

lors. He will therefore be a little astonished to find the Sharks of the Aquarium scarcely a yard in length, and will probably look upon them as either young Sharks or not as genuine ones. We would therefore remark that amongst the many forms of Sharks there are small ones which are however "true Sharks", as both they and the more common Dog-fish agree in their characteristics with the larger species. A comparison of the Rock Dog-fish (Fig. 174), with the Bass (Fig. 175), a bony fish, will quickly reveal these essential features.

Fig. 174. *Scyllium catulus*, $^1/_6$ nat. size.

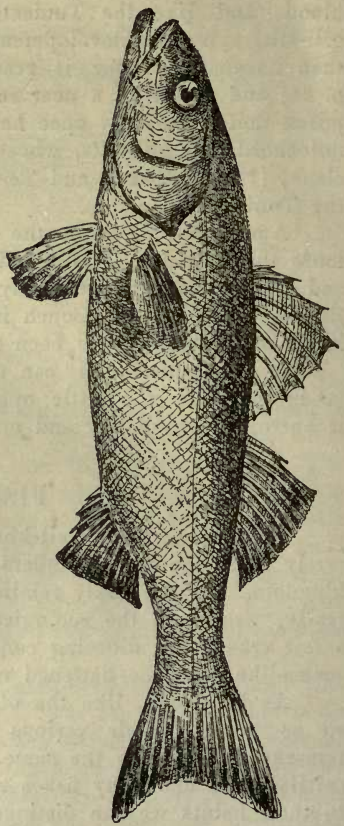

Fig. 175. *Labrax lupus*, $^1/_6$ nat. size.

The Bass is covered over its whole body with silvery fish-scales, has its mouth at the anterior extremity, two large moveable gill-covers, staring eyes not provided with lids, and nasal apertures distinct from the mouth. The body of the Shark on the other hand is not covered with scales, but with bony spines, which cause the skin to feel rough. The mouth is on the under side of the head in the form of a transverse

slit from side to side, and the neck has five or more gill-slits on each side, but no gill-cover. The eyes are provided with moveable eye-lids, the nostrils communicate with the mouth, forming a "hare-lip", a condition passed through by the embryos of all higher Vertebrates. These external characteristics alone would distinguish the Sharks from the bony fishes, but there are besides many differences of internal structure. The skeleton of the Shark, Ray, or Dog-fish, is all gristle, there being no bone except in the spines of the skin; where this bends over the jaws, they are enlarged to form the teeth. The anatomy in general is less advanced in specialization than that of bony fishes. The commonest genus is the Spotted Dog-fish, **Scyllium**, of which two species exist in all European seas, **S. catulus**, the Rock Dog-fish, or Bounce, as it is frequently called, and **S. canicula**, the Little Dog-fish or Morgay. The first is about a yard, the latter about two feet in length, so that they both belong to the smaller forms. They are lazy fishes, which seek their prey usually at night-time, and lie hidden in the corners of the tank during the day. They are fed on dead fish, which in day-light they find chiefly by their sense of smell, as their eyes are then quite useless; they search about close to the bottom of the tank, and only notice their food when they touch it with their snout.

The female lays its eggs singly on branches of coral (e. g. Tank Nr. 10 on the right) or attaches them to bushes or rocks. They are contained in rectangular, leathery capsules known as *Mermaid's* or *Sailor's purses*, semi-transparent and white when first laid, but afterwards becoming yellowish brown. The corners of the case are provided with long horny filaments, with which the fish attaches the eggs to the corals or other objects by swimming round and round them, as the egg is being pushed out of the body. Thus the eggs are prevented from being covered by the mud, which is one of the many enemies of the embryo. The development of the embryo can be very well observed owing to the transparency of the case; this reveals, in advanced stages, the young fish with a bunch of external gills, at either side of the neck, and the large yolk attached by a hollow cord through which the food substance is passed into the alimentary tract. Gradually the provisional gill threads disappear and the colouring of the body becomes more distinct. When the yolk is consumed, the young Dog-fish is ready to hatch; it forces its way out through one end of the egg-case, where the two plates of which it is formed are not firmly united, and then swims about freely in the tank. Eggs and embryos are often seen in the Aquarium, as the Dog-fish breed freely in tank Nr. 10, and the fishermen often bring in branches of coral and other objects, to which the eggs are fixed. (These may be seen in tank Nr. 21). These young stages have of recent years become very important in scientific research, and zoologists have drawn largely upon the material which this Aquarium provides. Economically, however, the Dog-fish is of very little use. Its flesh is of very indifferent quality and only eaten by the poor; the skin (shagreen) is used for polishing, and the liver yields a certain amount of oil.

Almost all sharks are viviparous, so that Scyllium is an exception to the rule.

The Smooth-hound or Ray-toothed Shark, **Mustelus** (Fig. 60), is only rarely to be seen in the Aquarium. This is one of the most harmless of sharks; its blunt flat-topped teeth are not fitted for devouring anything but crabs and mollusks, which it captures at great depths. When placed in tank Nr. 10, it swims about at first in a very lively manner with most graceful movements of its glossy body, but it soon tires, and finally cannot lift itself from the bottom of the tank; nor will it touch any food in captivity. Its flesh is quite good eating.

The Angel-fish or **Squatina** (Fig. 63), which forms a connecting link between the Sharks and the Rays, is an unsightly beast, always lying on the bottom of tank Nr. 10, and usually looked upon as dead by the visitors to the Aquarium. It is one of the most stupid and lazy fishes of the Mediterranean, and feeds on fishes frequenting like itself the muddy bottoms of the sea. Its very indifferent flesh is eaten by poor people, its rough skin is used for graters, sheaths for knives, and other purposes.

The true *Rays* have a flat body compressed from above, which has on its upper darker surface the eyes and two openings leading to the gills. On the lower paler surface are situated the mouth, the nasal apertures and the gill-slits. They are all deep-sea forms and live on the smaller animals frequenting the bottom of the sea.

The most interesting form is the Electric Ray, **Torpedo** (Fig. 65, tank Nr. 12), which was known to the ancients for its curious power of giving electric shocks. Its slimy body is almost circular in shape and contains two large "electric organs". Each of these consists of several hundreds of hexagonal columns of a gelatinous substance, which are supplied by a number of branching nerves with curious terminations. These organs give rise to a short and strong electric current when the animal is irritated, its upper surface being positive, the under surface negative; to experience the whole shock, the fish must be touched at the same time on both sides. The shock is not so strong as that of the South American Electric Eel, but is still sufficiently painful in an adult Ray. The shocks become feeblest when repeated frequently. The electric organ is used both defensively by the Torpedo and also for killing or at least numbing its prey. A young specimen is always kept in a small open tank, in front of tank Nr. 10, for visitors to try the electric power of the fish. — The Electric Ray is one of the most common fishes of the Bay of Naples and in spite of its poor flesh is often brought to market. They bring forth living young ones, 8—14 at a time. The very young embryos have still the shape of sharks and only later on become flattened and disk-shaped.

Of the other Rays the Skate, **Raja** (Fig. 69), and the Sting-ray, **Trygon** (Fig. 62), are found in the Aquarium, but the latter more rarely. The former have a lozenge-shaped body of brown colour, and a tail armed with a number of small spines. They lay their eggs in capsules, which are cast ashore on the beach of the North Sea and are called *Skate-barrows*. The Sting-rays are of dark violet colour and have a long slender tail. The latter bears a strong spine which can inflict terrible wounds and is considered poisonous by fishermen. They bring forth living young ones.

We have now reached the **Bony Fishes**, possessing all a bony skeleton and gill-covers, and here, too, we will start with those living at the bottom of the sea, where they pass their life hidden in the sand or mud, lying in wait for their prey. They swim about in a very clumsy way. They will be chiefly found in tank Nr. 24. The Star-gazer, **Uranoscopus** (Fig. 149), is an ugly brown fish with a large thick head and a body tapering off behind like a wedge. The small eyes are placed on the top of the head, hence its name, and the wide mouth is bent upwards. It generally lies buried in the sand and there often practises an ingenious stratagem. It protrudes from its mouth a long worm-like filament, which grows on its lower jaw, and lets it move about in the water; this allures fishes, which are anxious to catch what they suppose to be a worm, but are suddenly gulped in by the Uranoscopus. When disturbed from its sandy retreat, it swims about for a short time, but soon falls to the ground and with its shovel-like fins burrows into the sand again. It is very common in the Bay and is often seen on the market.

The Weever or Sting-fish, **Trachinus** (Fig. 150), is somewhat similar. It is small and slender and has bright shining eyes. When freshly caught and placed in the Aquarium, it soon drops to the bottom of the tank and buries itself up to the eyes in the sand. When fed, it darts rapidly out of its hiding place and snaps up the food, before it has fallen to the ground. At the same time (and also when angered) it erects its dorsal fins, the foremost of which has very sharp and poisonous spines. The wounds they can inflict are very dangerous, as they often cause violent inflammation.

The Fishing-frog or Angler-fish, **Lophius** (Fig. 58), is especially well provided with the means of attracting its prey. It is probably the most hideous monster among the fishes of the Mediterranean. The enormous flat head occupies almost three quarters of the body, and the wide mouth is provided with rows of murderous-looking teeth. The mud-coloured monster lies half-buried at the bottom of the tank and gazes upwards with its large expressionless eyes, while the small lappets and outgrowths of its lower jaw are moved about at each breath it takes. From time to time it raises the fin-rays of its head as a bait and lets their lappets move about. Thus it is a "Compleat Angler" with rods and bait and always ready to engulf with its gigantic mouth the small fry which the bait attracts. It lives in the mud in medium depths and often attains an enormous size. Unfortunately it does not last long in the Aquarium, as it cannot be made to take any food; visitors will therefore only rarely find it (tank 10). Young specimens and also another much smaller species are placed in tank 24.

In the same tank (No. 24) will be found the Soles. The *Flat Fishes* or Pleuronectidæ to which these belong, form a quite distinct group of fishes. Their body is laterally compressed i. e. from right to left, and the head is turned in such a way that both eyes come to lie on the same side (either right or left). The two sides are distinct in colouring. The side which in swimming or resting is the undermost, is white, like the ventral surface of many other animals. The other side,

which bears the eyes, has a dark colouring and possesses the power of matching itself to the colour of the bottom in a most remarkable manner. This protective colouring makes it very difficult at times to distinguish the specimens. The eyes will be the first objects to reveal themselves to the spectator; they can be moved about independently of each other in all directions, raised up or retracted, so that the fish commands a complete view of its surroundings. It catches its prey, consisting of small fish, by darting upwards and forwards with lightning-like rapidity. It swims with great skill, by wave-like motion of the body, the dark side being uppermost. A few strokes of the loose flaps of skin which encircle the body suffice to throw up sand enough to conceal the animal again, and then it will remain for hours awaiting its next prey.

Economically the Flat Fishes are very important, as their flesh is very delicate and keeps well, so that it can be transported to considerable distances. Some of them attain a large size. England, Germany, France, Holland and Denmark consume enormous numbers of Flat-Fish. London imports from Holland alone about £ 100,000 worth of Turbot annually, but this is only a quarter of the amount actually consumed in the metropolis; in the Italian markets, too, they are greatly prized. They are caught with the trawl-net, and also with the line. The chief forms of Flat Fishes are the Flounder, the Turbot and Halibut, the Sole and Plaice. Only the smaller species can be kept in the Aquarium, generally the Turbot, **Rhombus maximus** (Fig. 152), and the Sole, **Solea vulgaris** (Fig. 153).

Allied in habits to the fishes just described are those which have adopted the crevices of the rocks as their home and there lie in ambush for their prey. Foremost amongst these is the Sea-scorpion or Sea-devil, **Scorpaena** (Fig. 43), a heavily shaped fish with a broad head and mouth, large spiny fins, and curious appendages on its skin in form of lappets, horns or ribands. They hide themselves in the crevices of the rocks, and can mimic the colouring so wonderfully that visitors will at first not be able to distinguish them (tank Nr. 25). Some, in the semi-darkness of the water, bear a most striking resemblance to a rock covered with sea-weeds; so that they easily escape the notice of their enemies and also of their prey. The same is the case with the crabs in this same tank (see above p. 73); and in fact this protective colouring is found in many animals. Thus the inhabitants of the deserts are usually of a sandy colour. The Polar regions and the alpine heights are inhabited by white animals, some of which, like the ptarmigan, can even change their colouring according to the season of the year. The jelly-fish and the other pelagic forms protect themselves from their enemies by perfect transparency. Some insects and their larvæ mimic the plants, or portions of the plant, on which they live and feed. Others, again, mimic animals which are themselves well protected, as for example by the possession of defensive weapons or poisons. Thus some flies have adopted the appearance of bees or wasps, and many butterflies perfectly innocuous themselves, resemble very closely other butterflies which are very distasteful to insect-eating animals. This interesting phenomenon termed "Mimicry" has been observed in marine animals of almost every

class. — Scorpæna has poisonous rays in its dorsal fin, but it is not such a dangerous animal as the Sting-fish. A large species, of red colour and with curious eyes, **Scorpaena scrofa**, will be seen in tank Nr. 6.

Allied in habit to the Sea-scorpion is the Goby, **Gobius** (Fig. 68), a small, dark, ground-loving fish always to be seen at the bottom of tanks 12 and 26, generally hidden in a crevice of the rock or in a bunch of algæ, but more fond of movement than Scorpæna. Under natural conditions, in the spawning season they leave these hiding places and construct a chamber covered in by the roots of the sea-weeds, where they lay their eggs. The male fish is the architect of the nest, as is the case with the Sticklebacks. At the entrance to the nest he waits to entice females into it, and fertilizes the eggs as soon as they are laid. Then he protects the spawn for about two months and wards off most courageously all enemies. If a large number of females visit the nest, he enlarges it and provides it with several exits; this has also been observed in the Aquarium on some occasions.

The numerous species of the Blennies, **Blennius**, are small, very agile, predatory fishes which live in large troops in those parts of the coasts, which are covered with sea-weeds. Their mobile bodies are continuously darting about and, should danger threaten, they disappear at once into some hiding place. Their curiosity and "cheek" is extraordinary, and causes them to snap at everything, and to annoy whatever cannot protect itself. They nibble off the gills of the tubicolous worms, they make dashes for the eyes of crabs and fishes, and they worry the ascidians till the latter die. So they go on with all helpless animals. The finest and largest form is the Butterfly-fish, **Blennius ocellaris** (Fig. 158), which possesses a large black eye-like spot on each side of its dorsal fin.

Hidden away similarly among the rocks we find the Rockling, **Motella** (Fig. 151), which belongs to the family of the Cods.

The transition from these fishes, tied more or less to the bed of the sea, to the freely swimming fishes is formed by some good swimmers, which, nevertheless, have a preference for the bottom or the coasts and at times remain stationary like the previous forms, at other time swimming for considerable distances. To this group belong several species of Gurnards, **Trigla** (Fig. 75). The Gurnards are remarkable on account of the peculiar grunting sound they emit when taken out of the water. It is said not to be a real vocal sound, but only a frictional noise produced by the rubbing of certain hard plates of the gill-cover against underlying parts. They have also a peculiar way of "walking" about on the sand by means of the free rays of their pectoral fins (which are destitute of membrane), the so-called "fingers". The hinder part of the pectoral fins is very large and usually brilliantly coloured and enables the fish to leap out of the water. They are predatory fish, with a widely opening mouth, which will gulp down tremendous morsels.

A near ally is the Flying Gurnard, **Dactylopterus** (Fig. 77), which, however, in spite of its name does not appear to use its large pectoral

fins for flying through the air. (This, on the other hand, is done by the Flying-fish, *Exocoetus*; when they leave the water, they shoot along with rapid beatings of their fins, but fall into the sea again after a flight of about 100 paces, only to repeat the process. Most probably they are chiefly carried along by the wind, catching their large outspread fins, so that we cannot really speak of "flight". Often two shoals will follow each other in flight; if they keep to a fixed course, one may safely assume that they are pursued by some enemy. When they are near the coast, they attract the attention of gulls and other birds, which chase them from above.) The Flying Gurnards live in shoals at the bottom of the sea. Their flesh is tough and tasteless. They grunt like Trigla when caught. They are only occasionally seen in the Aquarium.

Like the gurnards the Red Mullet, **Mullus** (Fig. 71), lives in flocks on the muddy beds of the sea, feeling about for food with the two long barbules of its lower jaw. In the Aquarium the play of these tactile organs can be well studied. Sometimes they are moved about slowly, and with great deliberation, in the mud, sometimes they vibrate rapidly or are laid back into a furrow of the lower jaw. The Roman gourmands prized this fish very greatly and, when it was the fashion, they paid incredible sums for large specimens. They were also brought to the guests in glass bowls living, and, so as to enjoy the wonderful play of colours which they show, they let them die slowly in the hands of the women. Nowadays the Mullet under the name of *Triglia* in all Italian markets is a much sought but not very expensive fish.

The Eels, too, are inhabitants of the rocky beds. The Conger Eel, **Conger** (Fig. 61), and the Roman Eel, **Muræna** (Fig. 67) will be found in tank 11 where they generally hide themselves in the pots and vases and only let their heads be seen. In the sea they hide in the same way among the rocks. The Conger Eel is a very voracious fish which sometimes reaches the enormous length of 9 feet; and even in captivity, thanks to its tremendous appetite, attains very considerable dimensions. He will go so far as devour the young of his own species. It is not very much prized in the market, but forms a cheap food for the poorer classes.

The Muræna differs from the Conger in the absence of pectoral fins and in the beautiful colouring of its skin. It will, however, share its abode, and often two or three will be found crowded in a very small space. Their snake-like motion when swimming, their brilliant colour, the tall fin-like crest, and the curious head with its fixed eyes and constantly gaping mouth give them a very remarkable appearance. The Romans, as is well known, took endless trouble to be well supplied with this fish and went so far as to close off small bays of the sea for breeding them. According to Pliny, a certain Hirius is said to have placed before his friends 6000 Murænæ on the occasion of Cæsar's triumphal procession. Crassus was the owner of a large Muræna which he decked out with gold ornaments and cared for in every conceivable way, burying it after its death and weeping over its grave. Vedius Pollio is said to have drowned several of his slaves, as a punishment

for some fault, in his Muræna ponds, as he had heard that, when fed on human flesh, the Murænæ were the most delicate. Even to-day the Muræna is greatly prized, and the classic bay of Pozzuoli is one of its most famous marts. They are caught in creels or pots, called "Nasse", or with the line, on which they sometimes struggle with great vehemence and are not easily overpowered, as they are very vicious and too smooth and slimy to be firmly held. The fishermen consider their bite poisonous; but it is probably only the shape of their sharp bent teeth which causes the wounds to heal so slowly. In the Aquarium they can be kept for years. Recently it has been proved that their blood acts as a violent poison (as does that of the Common Eel) when injected into the blood of a mammal.

A quite unique appearance amongst fishes is afforded by the Sea-horse and its allies, which are collectively classified as *Lophobranchii* or "tuft-gilled" fishes, on account of the form of their gills. Every one will know the Sea-horse, **Hippocampus** (Fig. 130), which is sold dried, as its hard skin preserves the shape of the animal. The life and habits of these fish, so common in the Bay of Naples, are very attractive. Everything about them seems as different from other fish, as is their shape, which reminds one of a gracefully carved chess figure. They seem to do best where plants or worm-tubes give them plenty of opportunity of fastening themselves with their finless tail. When swimming in their graceful manner, their dorsal fin is in constant wave-like motion. They float up and down, bend themselves about, chase each other, or swim in couples clasping each other with their tails, or in other laughable attitudes. This playfulness is chiefly exhibited in autumn, which is their breeding season; and loving couples may be seen swimming or resting together and billing each other like a pair of turtle-doves. The eggs as soon as laid are received by the male animal, which carries them about in a pouch on its ventral surface until the young are fully developed. As his family become more and more lively within the pouch, they cause so much irritation that the father considers it time to get rid of them; this he does by successive abrupt bendings of that part of the body which bears the pouch. At each bend the pouch opens and a number of small beings are expelled, separating immediately and swimming about very actively; their size is about a sixth to a quarter of an inch. — Economically the Sea-horse is of no value whatever. It seems to have no enemies in the sea; in the Aquarium, at least, where it has been kept with all sorts of animals, it is never touched.

To the Lophobranchii belongs also the Pipe-fish or Needle-fish, **Syngnathus** (Fig. 103). They live in the beds of Posidonia and resemble most accurately, both in shape and colouring, the dying leaves of the latter. The male of this animal also takes care of the eggs till they are hatched.

The freely swimming fish to which we shall now turn contain most of the well known sea fish. They pass most of their life floating or swimming, and thus prove that they have a complete mastery over

the element in which they live. But a number of them also frequent the coasts, from habit or in search of food; while others swim about to greater distances, or may, like the pelagic fish, become independent of coast and sea-bottom and live in the open water.

We shall first treat of those forms which frequent the coasts, beginning with the Labroida, characteristic by their large protrusible lips and conspicuous by their brilliant colouring. The brightly coloured Wrasse, **Labrus** (Fig. 35 and 36), and the Peacock-wrasse, **Crenilabrus** (Fig. 34), belong to this group; they swim about with a curious jerking motion. The gaily coloured **Labrus festivus** is interesting on account of the close watch the jealous male animal keeps over its brood. The small **Coris vulgaris** and **Julis pavo** (Fig. 157 and 155) are graceful and brilliant fishes darting about the tank. They are possessed of intense curiosity and great greediness, devouring instantly anything that is thrown to them. They are very sensitive to the cold, and retire into the sand at night; so that on a nocturnal visit to the tank only their heads can be seen protruding from the sandy bed. In cold wintry weather, they remain in the sand all day, and always take refuge there when alarmed. — The larger species of Labrus and Crenilabrus may often be seen resting at the bottom of the tank leaning against a rock or stone, reminding one of the ground-loving fish.

Nearly allied is **Xyrichthys** (Fig. 156), which behaves exactly like Coris, and the small **Heliases** (Fig. 32), troop of which play about on all steep coasts.

In sharp contrast to these lively fishes are the phlegmatic Sea-perches, the largest and most easily kept of which is the **Serranus gigas** (Fig. 56). It loves to remain for hours on the same spot, generally where the water enters the tank, sometimes in an upright position with widely opened mouth and gill-cover, and seems to enjoy the stream of freshly aerated water which passes through its gills. When alarmed it takes refuge under some arch of the rocks and from there darts out on its prey with rapid and unerring aim. All its habits characterize a cautious, timid fish, loving safe hiding-places; and with this view the observations of the fishermen agree. It is greatly valued and sought after in the Italian markets, going by the name of *Cernia*, and fetches good prices. — The small Lettered-perch, **Serranus scriba** (Fig. 72), with a brilliant colouring, resembles in shape, though not in appearance, its larger relation. It has received its name from the marking like Arabic writing upon its gill-covers. We may also mention in this connection the fine rose-coloured **Apogon** (Fig. 33).

Much more lively than the "giant" Serranus is the Bass or Seadace, **Labrax lupus** (Fig. 55). It is a predacious fish, occurring in the Mediterranean and the Atlantic, and was well known at the Roman time. It attains a length of three feet and is one of the most delicate fishes in the market, where it is known as *Spinola*. It is usually found near the coasts and sometimes proceeds some way up the rivers. In stormy weather it approaches the coast in large numbers to feed on the crabs which are carried away by the waves. It is generally caught with the line, large specimens offering very energetic resistance. In the

Aquarium it lives for years and will spawn freely, but unfortunately the young have not been able to be reared.

Perhaps the most common fishes in the Bay are the different species of Grey Mullet, **Mugil** (Fig. 46). They are easily distinguished by their slender, silvery grey bodies, and their curious lips. The upper lip is provided with a notch into which fits a process of the lower lip. They swim round the coasts in shoals and live on soft decaying matter. In tank Nr. 16 they will be seen feeding on the sea-weeds and on decaying animal and vegetable products, so that they are distinctly useful animals. Their flesh is very good, and as they are very common, they form a staple article in the Italian markets (*Cefalo*).

We have further to mention a number of fishes, which are always to be found in the Aquarium, but possess no very striking habits, and scarcely need a detailed account, very little being known of their life. First come the Sea-breams, much sought for by fishermen on account of their splendid flesh. They comprise the Snapper (**Pagellus erythrinus**, (Fig. 37); **Box** (Figs. 12 and 13); and smaller allied forms, such as for instance **Oblata** (Fig. 14). When in the sea they hunt together in large numbers the smaller Crustacea and other animals; though in part they live on vegetable food. Besides these we have larger forms, such as the Sar, or Goatbream, **Sargus** (Fig. 41), **Smaris** (Fig. 76) and the more rarely found Black Bream, **Cantharus** (Fig. 40); of which last one specimen lived for five years in the Aquarium. The most valuable are the Gilt-head, **Chrysophrys** (Fig. 38), and the Toothed-bream, **Dentex** (Fig. 39), with metallic markings on the upper half of the body. The former is caught all over the Mediterranean, often in salt water and brackish lakes and lagoons, where it feeds on shell-fish and is therefore caught with such bait. The Romans bred them in ponds, the Lucrine Lake yielding a large supply. The Toothed-bream is the largest of all, attaining a length of 3 feet and weighing over 20 pounds. It is a predatory fish and often fetches the catch out of the nets. In the Aquarium it displays great activity and agility; one of these, also, lived here for 5 years and was killed by an accident. By the side of the brilliant Breams the black Sea-crow, **Corvina** (Fig. 57), is conspicuous by its sombre appearance. It is a quiet fish, usually associating with companions of its own species, and examining the bottom of the tank with great deliberation. **Umbrina** (Fig. 42), which is very like it, is of more rare occurrence.

Of the family of Herrings may be mentioned — besides the Herring itself, **Clupea harengus**, which occurs only rarely in the Bay — the Pilchard or Sardine, **Clupea pilchardus**, and the Anchovy, **Engraulis encrasicholus**. The latter was known to the ancients, but this is not the case with the Sardine or the Herring. Anchovy-fishery is only of importance on the French coast, for the so-called *Anchovy* which is imported from Norway is nothing but the Common Sprat, **Clupea sprattus**. Sardines, on the other hand, are as frequent on the English as on the French coasts, but are known to our fishermen as Pilchards. They are salted down in barrels and exported to Italy — particularly Naples — to the number of 60 or 70 million fish a year; principally

for consumption during Lent. The French Sardines differ only in size; the fish are cleaned, salted, plunged into boiling olive-oil, and packed in the tins with which we are familiar; they are sold annually to the value of 10 to 15 millions of francs. The experiment has been made with some success of similarly treating the English Sardines.

The whole genus *Clupea* is ill-suited for a life in captivity, and the Sardines will never be seen in the Aquarium; all the experiments to keep them there have resulted only in their rapidly losing their scales and dying. Visitors, however, will probably have an opportunity, during their stay in Naples, of recognizing them in their fried condition at the dining table.

A fish only found in the Aquarium at certain seasons is the Bellows-fish, also called the Trumpeter or Sea-snipe, **Centriscus** (Fig. 54).

The peculiar order of Plectognathi are characterised by the possession of an immobile upper jaw and a spiny or armoured skin. They are almost all tropical forms; many, such as the Urchin-fish or Sea-hedgehog, the Globe-fish, and the Trunk-fish, are usually well represented by dried specimens in Natural History Museums. The Bay of Naples contains two examples of this curious order of fishes: the Sun-fish, **Orthagoriscus**, and the File-fish, **Balistes** (Fig. 76). The former has up to the present been one of the greatest rarities of the Aquarium, and has rarely lived there longer than a week, so that we can give no interesting details of its habits. Balistes, however, is always present (in tank 18) from spring till winter, and is very remarkable; its short body being out of all proportion in height, and its mouth provided only with very few teeth. It is a lively fish, loving companionship, and endowed with great curiosity. It is, however, only in summer that it shews its real nature, and specimens in the Aquarium always die at the commencement of the winter. It lives on mollusks and crabs, which it grinds up with its sharp teeth, making so much noise in so doing, that it can be heard through the glass of the tank. It used formerly to share a tank with the Turtle, but never let the latter get a meal; and it had to be separated from the Lobsters, as it used to attack their eyes.

We may now turn to the true pelagic "errant" forms, the Mackerels. Just as the Petrel and the Frigate-bird spend their life hovering over the endless expanse of the ocean, so the Mackerels rove about below the surface of the sea; approaching the coasts only periodically, when, however, they are caught in enormous numbers.

Repeated trials to keep these shy but active fishes in the Aquarium have been unsuccessful. Nor can we expect the Tunny, or its ally the Swordfish, those two roving forms, to live in the cramped surroundings of our tanks. They all career about madly for a few hours and then die. Only one small genus of Mackerel, **Lichia** (Fig. 44), becomes accustomed to its captivity and lasts out like Balistes during the summer months; its skin shines like silver. To the same order as the Mackerels belongs the "Cuckoo", **Capros** (Fig. 53). Unlike its relations it lives at a depth of 30 to 40 fathoms, but it also thrives well in the shallow water of tank Nr. 9.

REPTILES (REPTILIA).

Beside Amphioxus and the numerous orders of fishes only one other vertebrate animal is found in the Aquarium, but this one is all the more imposing. It is the Caouana, **Thalassochelys** (Fig. 64), a Mediterranean turtle, which grows to much more than 3 feet in length and may attain a weight of 400 pounds. It is found on all coasts of the Mediterranean and on the European shores of the Atlantic. It feeds con crabs and other small animals and fights most desperately when aug ht, its sharp jaws being a most formidable weapon. In captivity, too, it retains its ferocity for some time, and the specimens in the Aquarium have occasionally had such severe fights, that now they are mostly isolated. In the winter they become lazy and lose their voracious appetite. They are economically speaking valueless, as the flesh is tasteless and the shell or carapace cannot be worked.

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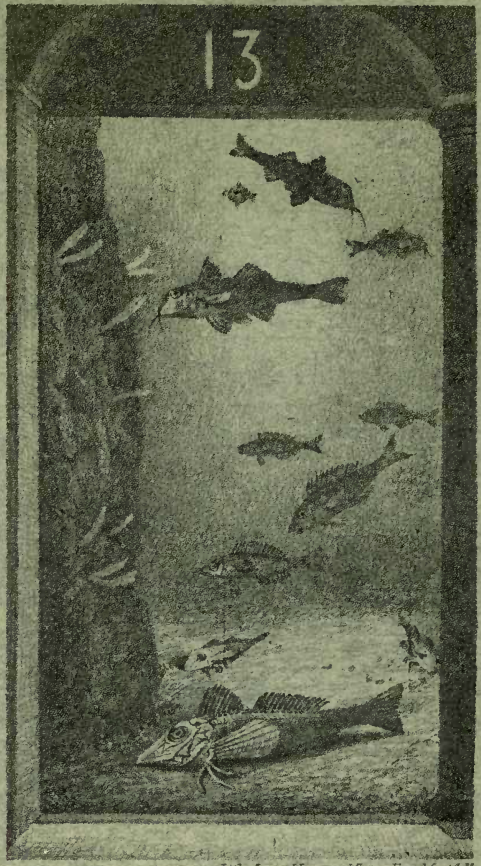
PART SECOND.

C. Merculiano fec.



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